# The Journal of HEREDITY

*A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics*


THE IMPROVEMENT OF ROOT-STOCKS . . . . H. J. WEBBER

CROSSES OF DAIRY AND BEEF CATTLE . . . JOHN W. GOWEN

HERITABLE CHARACTERS OF MAIZE . . . J. H. KEMPTON

THE IMMIGRATION PROBLEM TODAY . . . ROBERT DE C. WARD

ARE VALENCIA ORANGES FROM CHINA? . . . LEE AND SCOTT

INHERITED SYNDACTYLY IN MAN . . . RALPH G. HURLIN

RACIAL DIFFERENCES IN MORTALITY



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## Making a New Breed of Poultry

is the title of an article soon to appear in the JOURNAL OF HEREDITY. It is written by Harry M. Lamon of the U. S. Department of Agriculture. The photographs which accompany it make the article a pictorial story of the Government's work covering eight years of breeding experiments not heretofore published.

SOME OTHER ARTICLES OF SPECIAL INTEREST ARE:

INHERITANCE IN SWINE, by J. L. Lush, University of Wisconsin.
DUTCH BELTED CATTLE, by K. Kuiper, Jr., Havelte, Holland.
GENETICS OF HEREFORD CATTLE, by W. E. Castle and W. L. Wachter, Harvard University,
Heritable Characters of Maize:
ZIGZAG CULMS, by W. H. Eyster, University of Missouri.
SHRUNKEN ENDOSPERM, by C. B. Hutchison, Cornell University.
WHITE SHEATHS, by J. H. Kempton, U. S. Dept. of Agriculture.
A HERD OF ALBINO CATTLE, by J. A. Detlefsen, University of Illinois.
HEREDITARY BEHAVIOR OF A HEN WHICH CHANGED COLOR, by W. A. Lippincott, Kansas Agricultural Experiment Station.
BETTER AMERICAN FAMILIES (2 papers), by Wilhelmine E. Key, Battle Creek, Mich.
INBREEDING AND CROSS-BREEDING CREPIS CAPILLARIS, by J. L. Collins, University of California.
EFFECT OF THE LENGTH OF DAYLIGHT ON PLANT DEVELOPMENT, by W. W. Garner, U. S. Dept. of Agriculture.
RELATION OF DIET TO TEETH, by P. R. Howe, Harvard University.
HEREDITY OF EYE DEFECTS IN RABBITS, by M. F. Guyer, University of Wisconsin.
VARIATIONS IN WILD TAR WEEDS, by E. B. Babcock, University of California.
INHERITANCE OF SIZE IN RATS, by Hemen L. Ibsen, University of Kansas.
PARASITIC WASPS, by P. W. Whiting, St. Stephens College, New York.
SELECTING HOLSTEIN-FRIESIAN SIRES FOR HIGH YEARLY PRODUCTION, by R. E. Hunt, Virginia Agricultural Experiment Station.
INHERITANCE OF MENTAL TRAITS, a review of Dr. Starch's new work.
DETERIORATION IN SOME HORTICULTURAL VARIETIES THROUGH DEFICIENT ARTIFICIAL SELECTION, by H. H. M. Bowman, Toledo University.
EXPERIENCE WITH HYBRIDS, by H. Ness, Texas Agricultural Experiment Station.

Most of these articles represent years of patient research work. Told in the words of the research workers themselves, and accompanied by original photographs—the testimony of the camera—the discussions will interest and deserve a very large audience. As only enough Journals are printed to supply the membership at the time of publication, names of new members should be received at once in order to get these articles. Nominate a new member by letter today.

## The American Genetic Association

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*The*

# Journal of Heredity

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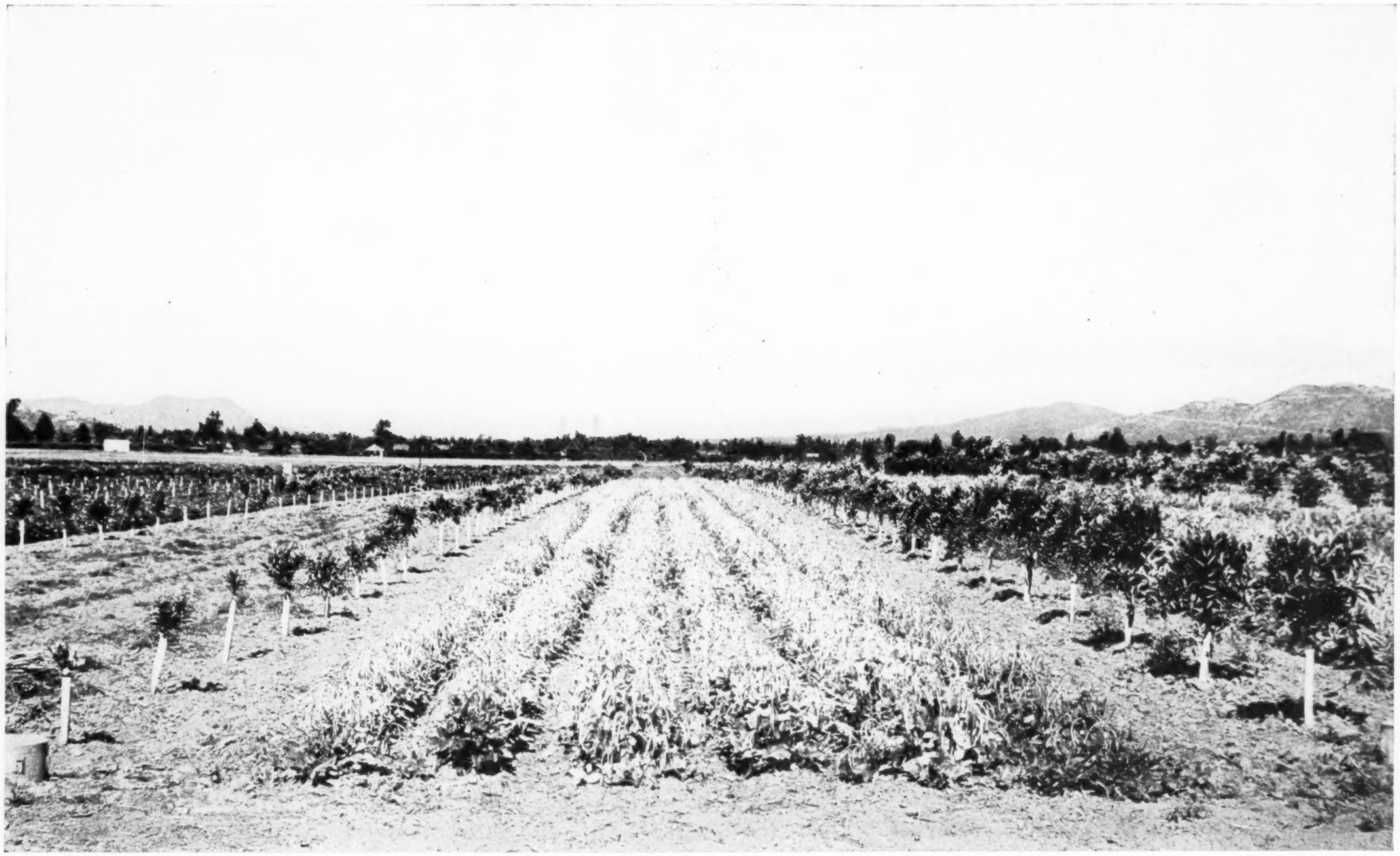

**COMPARATIVE TEST ROWS OF LARGE, INTERMEDIATE AND SMALL NURSERY TREES OF WASHINGTON NAVEL ORANGE**

Citrus orchards show great variation in the yield of different trees in the same orchard. Nursery trees of the same age, ready for sale, often exhibit great diversity in size. Does this variation mean anything in bearing qualities? To determine if these differences were of any importance, a test was begun at the Citrus Experiment Station, Riverside, California in 1917. A row of large trees is shown at the right in this photograph, a row of small trees at the left, and a row of intermediate trees at the extreme left. They were planted in June 1917 and photographed May 1919, still retaining their relative sizes. (Frontispiece.)

# THE IMPROVEMENT OF ROOT-STOCKS USED IN FRUIT PROPAGATION

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FOR many years it has been clearly recognized that the root-stock has an important influence on the scion and on the quantity and quality of the crop produced, yet very little experimentation has been devoted to root-stock problems or to the determination of the best stocks to use.

It is true that these matters are discussed at almost every convention of fruit growers and much information based on experience has been recorded. In general, the discussion and indeed all consideration has been limited to the effect on different varieties of certain root-stocks which are themselves usually very variable species. In citrus fruits, for instance, all consideration has been limited to a discussion of whether one should use sour orange (*Citrus aurantium*), sweet orange (*Citrus sinensis*), grapefruit (*Citrus grandis*), lemon (*Citrus limonia*) or trifoliate orange (*Poncirus trifoliata*). These species are not composed of stable, uniform groups of individuals but are exceedingly variable, each containing many hundreds of different types. No attention has been given, however, to the reactions that may be expected from the use of different types within the species. The same statement applies equally well to the various stocks used for apples, peaches, pears and similar fruits.

It seems clear to the writer that this is fundamentally wrong, and yet before any generally accepted policy can be overthrown, evidence must be found definitely to show that it is wrong. The writer for the last five years has been engaged in the study of this problem in connection with citrus fruits and the evidence obtained will probably apply just as definitely to other fruits as to citrus. The following is an outline of the experiments and results of a study of this problem with different varieties of citrus.[1]

## VARIATIONS IN NURSERY AND ORCHARD TREES

Citrus orchards show great variation in the yield of different trees in the same orchard. This variation is known to be universal even in orchards of the same variety that have been planted with the best obtainable trees. Some orchards are quite uniform, however, while others are exceedingly variable. Batchelor and Reed have shown[2] that the trees in the most uniform groves will vary from 30 to 40 percent of the mean.

Mr. A. D. Shamel and his associates of the U. S. Department of Agriculture have emphasized the relation of the character of the buds used in propagation to this variability in the orchard and have rightly urged the importance of choosing buds for propagation from uniformly high yielding trees known to produce only fruits of standard type.[3] Is this the only factor involved?

It is a well known fact that nursery trees as they are normally grown when two years old and ready for sale exhibit great diversity in size, the trunks frequently ranging from ⅜ inch to 1½ inches in diameter. Does this variation in size of trees of the same age

[1]Webber, H. J. Selection of stocks in citrus propagation, California Agricultural Experiment Station Bulletin 317, January, 1920.

[2]Batchelor, L. D. and Reed, H. S. Unpublished investigations.

[3]Shamel, A. D. *et al.* Citrus fruit improvement, U. S. Department of Agriculture Bulletin 623, July 22, 1918; Bulletin 624, July 25, 1918; Bulletin 697, Sept. 27, 1918 and Farmers' Bulletin 794.

WASHINGTON NAVEL ORANGE TREES

These are average-sized trees chosen from the test rows of large, medium and small nursery trees planted in the orchard in June 1917 and photographed May 1919. They have now been in the orchard three years and still retain their comparative differences in size, each grade, from the smallest upward, being about two years behind the next larger one in development. (Fig. 1.)

mean anything or is it purely accidental? All of these trees are ordinarily sold and planted. Probably these differences in size are due to the same or similar causes as those responsible for the differences in size in bearing orchard trees.

A nursery grown at the Citrus Experiment Station for experimental purposes was planned with the idea of producing as uniform trees as possible. The sweet seedling stock used was thus selected when it was planted in the nursery, many of the small trees being discarded. Through the kindness of Mr. Shamel, the buds used for propagation were taken from record trees of standard type in order to further insure uniformity. Valencia and Washington Navel oranges, Marsh Seedless grape fruit and Eureka lemon were the varieties grown. When this nursery was two years old and ready for orchard planting the trees were found to show the same variations in size of buds that have been referred to as being universally present in ordinary nurseries. Had buds been taken indiscriminately from ordinary trees this variation would have been passed by as normal. As it was, this fact lead to a test of the different sizes of trees to determine, if possible, whether these differences in a nursery were of any importance in growing an orchard. Eighteen large, eighteen small and eighteen intermediate sized budded trees of each variety were selected and planted in comparison rows in the variety orchard at the Citrus Experiment Station, Riverside, California. These trees were all dug "bare root" to see that the roots were normal and not injured or diseased. All trees used in the experiment were normal and thoroughly healthy so far as could be determined. They were planted in the orchard in June, 1917. The severe heat coupled with "bare root" planting injured so many of the Eureka lemons that this variety was eliminated from the experiment. The Navels, Valencias and Marsh Seedless grapefruit stood the transplanting very well.

These trees have now been in the orchard three years and are five year old buds. They still retain the same comparative difference in size just as markedly as when they were transferred from the nursery. The large trees retain their lead and are still large. The intermediate are still intermediate in size and the small are still small. After two years in the orchard the small trees were about the same average diameter that the intermediate trees had when they were transplanted and the intermediate sized trees after two years in the orchard were about the same average diameter as the large trees when they were transplanted. Each grade is thus about two years behind the other in development. (Compare Frontispiece and Figs. 1 and 2.)

To get some indication of the comparative average size of the tops of the different groups, the top diameter of each tree was measured east and west, north and south and the height from the lowest branch to the top of the foliage. These measurements for each tree were multiplied together to give the volume of the cube that would enclose the top. The averages of these figures for each group in each variety are given in the following table.

*Average Comparative Size (in cubic inches) of Tree Tops, as Indicated by Product of East and West Diameter x North and South Diameter x Height from First Branch to Top.*

| | *Large* | *Intermediate* | *Small* |
|---|---|---|---|
| Navels | 54,174 | 20,185 | 12,541 |
| Valencias | 29,003 | 15,606 | 12,953 |
| Grapefruit | 26,343 | 15,827 | 10,642 |

While admittedly such figures are not exact measures of the top volume, they are believed to represent fairly accurately the comparative sizes of the trees in each group.

## FACTORS CAUSING VARIATION

To what factors could this variation be due and is it of any importance in citrus propagation? A difference in the soil or in the nutrition available might cause variation in size but this cannot be the main cause of the varia-

tion in size of these trees as they showed the difference in the nursery and continue to show it three years after transplanting into the orchard. In the orchard they are planted close together on uniform soil and are treated alike, so the difference cannot be attributed to local soil condition or nutrition.

Is the difference due to the character of the bud union? The buds seem to have healed nicely in all trees used and exhibit no characters indicating that the formation of a poor union could be considered as causing the difference.

Is it due to the roots having been injured thus resulting in dwarfing the tree? The roots were all examined when the trees were transplanted and all were found to be healthy and uninjured. Any injury or disease contracted since the trees were transplanted could not be limited to the small tree rows only.

Is it due to the kinds of buds used? All that can be said regarding this is that the buds were carefully selected from trees of known record and standard type. It does not seem that the difference is to be explained in this way although this possibility cannot be entirely eliminated.

### IMPORTANCE OF SEEDLING STOCKS

The only other factor that is likely to be the cause of the variation is the influence of the stocks used. The sweet orange stock used was merely ordinary sweet orange seedlings grown from unselected seed, the only extra precaution taken being merely to discard the smallest seedlings when transplanting from the seed bed. About 15 percent of the total number of seedlings were discarded at that time. The universal custom pursued at present is to use either sweet, sour, grapefruit, lemon or trifoliate orange stock without reference to any particular kind within these great groups. Are the variations within the ordinary lots of sweet and sour orange seedlings sufficiently great to be assumed to account for these variations in size of nursery trees? Fortunately some evidence has been secured bearing on this point.

In 1915 the writer, with the help of Mr. W. M. Mertz and Mr. E. E. Thomas, made an examination of one sour orange nursery and selected sixteen seedlings that appeared to show different characters. At the same time in the same nursery four different types were selected in a bunch of sweet seedlings. A more detailed examination would doubtless have revealed many more types but the only object in view at that time was merely to add "freaks" to our variety orchard. Buds were cut from each of these seedlings and two sour orange stocks were budded with each type. The trees from these buds are now five years old from the bud and have been set in the variety orchard for three years. All of the types selected present marked differences in size, foliage, character of branching and the like. The good vigorous types in the case of the sour orange selections are five times, or more, larger than the slow growing dwarf types. An indication of this great difference can be obtained by comparing the photographs of three typical trees shown in Figure 3, A, B and C. A represents a fine, vigorous, growing sour orange type while B and C represent slow growing, probably dwarf types. Similar differences in leaf size and shape are also exhibited. Compare for instance the size of leaves in A with those of C, which are both healthy trees. Two trees out of 16 of the sour orange types selected have lost the typical aroma of the sour orange, so far as the leaves are concerned. The four types of the sweet orange also differ in similar way in size and foliage characters.

The great extent of this range of variation within the different species is shown equally as well by the large number and range of the named varieties that are grown.

The sweet orange and sour orange seedlings grown for stock purposes are usually or at least frequently grown from seed, of unknown origin, and taken from different trees. We are not dealing with a homogeneous lot but with lots in which every individual differs from every other individual and

MARSH SEEDLESS GRAPEFRUIT TREES

Average-sized trees chosen from the test rows of large and small nursery trees planted in the orchard June 1917 and photographed May 1919. These, too, have continued to show the same comparative difference in size as they had when in the nursery. (Fig. 2.)

yet our policy has uniformly been to use all—good and bad alike—for propagation. Is it any wonder under these conditions that our trees though grown from the best selected buds should be variable in the groves?

The Eureka lemon on a trifoliate stock is very markedly dwarfed while Valencias grow to good sized trees. The Florida rough lemon is usually a good stock while the Chinese lemon is commonly recognized as a poor stock. Different reactions on the bud caused by the influence of different stocks are well known to exist. When therefore such marked differences are found to exist in the sour and sweet orange seedlings that we are using as stocks, is it any wonder that the budded trees in the nursery, even when selected buds are used, should grow differently and produce large and small trees and that these differences should continue to exist when the same trees are grown in the orchard?

The evidence now available very strongly points to the conclusion that the differences in size of nursery trees such as those taken for the experiment outlined are mainly to be attributed to the different nature of the seedling stocks used. If this is true, and it is entirely in line with the evidence as well as with common sense and judgment, it is certainly an element of fundamental importance in citrus propagation.

I would be remiss in caution if I did not call attention to the fact that one very important link in the chain of evidence is yet lacking, that is, the growing of good buds on known stocks of these various types to prove that certain ones give better growth than others. This evidence, however, is partially supplied by our known ex-

A B C

**DIFFERENT TYPES OF THE SOUR ORANGE**

A, a good, typical form with vigorous growth and excellent foliage and branching characters, selected as a good stock type; B, a type of medium size and rapidity of growth; C, a slow growing dwarf type with small leaves. (Fig. 3.)

perience of the reaction of buds on different stock such as referred to above.

### DIFFERENCES INHERENT IN STOCKS

Will the small trees continue to remain small? Certainly the evidence thus far indicates that this is very likely. The probabilities are that they will. Dr. Reed of the Citrus Experiment Station carried out a series of experiments[4] with a considerable number of sunflower plants that has a bearing on this phase of the problem. In this group of sunflowers, exact measurements of height were made of each plant every week from the time it was a few inches high until it reached maturity. The analysis of the data of growth obtained showed a well marked tendency of the plants to retain their same relative rank as to size throughout the period of growth. Plants which were small at maturity were generally small in the beginning and those which were large at maturity had a well marked superiority from the start. The evidence indicated that height and vigor of growth were determined not by chance but by some definite inherent factor in the plant itself. The same is doubtless true with citrus seedlings of the various species such as those used for stocks and if the cause of the different sized nursery trees is to be attributed primarily to the influence of these stocks as seems probable, then it is also probable that the difference is due to causes inherent in the different stocks and that the same relative rate of growth and size will be maintained in the majority of the plants.

While the evidence is yet incomplete, we are probably justified from what evidence we have in speculating somewhat as to what this means in our fruit industries. Frequently, almost every tree in an orchard will be a fine good grower and fruiter, giving a uniform orchard. Again, an orchard equally well handled may be very ununiform having some good trees, some poor ones and some of intermediate character. This difference could be accounted for by assuming that the good orchard chanced to be from trees grown on stock that happened to come from seeds of good stock trees or that they had been taken from a nursery where in filling the order of size only the large trees had been dug, which would be the ones naturally on good vigorous stocks. The remaining slower growing trees from such a nursery would ultimately reach the required size and be sold and planted in another orchard which would likely give an uneven orchard with good and bad trees.

Some growers will be inclined at first to think that their experience is contrary to this and that the small tree is more likely to be fruitful while the largest trees are likely to spend their energy in vegetative growth. They must remember that this experience was gained before buds of selected type were used. Mr. Shamel has demonstrated that some types of our varieties tend to produce rapid growth and little fruit while others produce good growth and are fruitful. The results the writer is explaining, however, were obtained with the use of buds taken from the best fruiting types and it is not likely that this type will be changed materially by the stock other than in size of growth.

### NEW NURSERY METHODS SUGGESTED

If the results of these experiments are correctly interpreted by the writer it means that our nursery methods in citrus propagation must be materially changed.

(1) We must no longer grow merely sour stock or sweet stock and the like. The process must be carried farther and good stock varieties of sour orange and sweet orange must be discovered and named as stock varieties and every nurseryman should then use seeds from these varieties known to produce good stock seedlings. The trees of these varieties from which seeds are to be

[4]Reed, H. S. Growth and variability in Helianthus. American Journal of Botany, Vol. 6, 1919, p. 252.

TWO TYPES OF FRENCH CIDER APPLE TREES

The tree at the left (Marechal) is a small, slow growing variety; the one at the right (Julien de Paulmier) is a large vigorous growing variety. Both of these trees are growing in the U. S. Department of Agriculture's orchard at Arlington, Va., and they are of the same age and on same stock, indicating that the same variation in size applies to other varieties than citrus. (Fig. 4.)

taken to grow stocks must be planted in isolated places so they will not be crossed with other varieties.

(2) Good policy will doubtless dictate that all small seedlings be discarded when transplanting from the seed bed into the nursery. Doubtless nearly 50 percent of the seedlings should be discarded at this time. The writer believes that a severe culling of the seedlings may unhesitatingly be recommended.

(3) In budding a nursery no inferior seedlings found in the nursery should be budded. Doubtless we will hereafter carefully inspect the seedlings just before budding and cut out all inferior ones to save the expense of budding them.

(4) When the budded trees reach the age for transplanting into the permanent orchard only the good, vigorous, growing ones should be used.

The writer assumes that hereafter only buds from trees of known good record and of standard type will be used in propagation. This is already recognized as the only correct and safe policy.

### VARIATIONS IN APPLE STOCKS

The evidence secured with citrus varieties discussed above doubtless applies equally well to other fruits such

as the apple. In Australia and South Africa Northern Spy roots have been found to be resistant to the woolly aphis, and apple varieties are now largely propagated on this variety.[5] Professor J. K. Shaw has recognized the importance of this problem and has conducted extensive experiments in the attempt to grow apple trees on their own roots.[6]

Apple varieties are largely grafted on the French crab or cider apple stocks, the seeds or plants of which are obtained in large numbers from France. Several years ago a considerable number of the different types of these cider apples were selected in France by Professor Alwood and two trees of each of these different types are now growing in the variety orchard of the U. S. Department of Agriculture at the Arlington Farm near Washington, D. C. In November, 1919, the writer had the privilege of making observations on these different types in company with Professor L. C. Corbett and Dr. D. N. Shoemaker, horticulturists of the Department. The variations in the different types are fully as extreme as those found by the writer to exist in citrus fruits. These trees are of the same age and planted on comparatively the same soil and yet some of them are dwarfs while others are giants. As an illustration the two trees of the Julien de Paulmier are much larger and more vigorous than those of the Marechal. Photographs, of the same comparative size, of trees of these two types were made at the writer's request by Dr. Shoemaker and are reproduced in Figure 4. Seedlings grown from fruits of the Marechal could scarcely be expected to give the same results when used as stocks as seedlings from the Julien de Paulmier. Yet if the writer is correctly informed the seed we use in growing apple stocks are likely to be taken from many different types which are probably as markedly different from each other as are these two. We may desire to use a dwarf stock in some cases and a giant stock in other cases but certainly we should know what we are using.

In the propagation of grapes the specialization has been carried much farther and here a great fund of information has been obtained showing that with certain varieties only certain hybrid stocks will give good results and that on some soils only certain stocks may be successfully employed.

In fruit industries where the trees may grow for many years, possibly even for a century or more, and where continued success depends as much on the stock used as on any other single factor, is it too much to require that the stocks used should be of known quality? The writer maintains that all trees should be propagated on selected stock varieties of known origin and kind.

[5]Cole, C. F., in Journal Agriculture Victoria, Vol. 9, 1911, p. 338.
[6]Shaw, J. K. The propagation of apple trees on their own roots. Massachusetts Agricultural Experiment Station, Bulletin 190, 1919.

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## FOR THE HARD-OF-HEARING

It is estimated that one person in every 1500 population is deaf, and that out of this number one-third are of school age. Any hard-of-hearing person may secure literature that may prove helpful, by addressing the Volta Bureau, 1601 35th St., N. W., Washington, D. C. The Bureau does not give medical advice, has no medicines or instruments for sale, and does no teaching.

# INHERITANCE IN CROSSES OF DAIRY AND BEEF BREEDS OF CATTLE

## II. On the Transmission of Milk Yield to the First Generation.[1]

JOHN W. GOWEN
*Agricultural Experiment Station, Orono, Maine*

FOUR main problems are of particular interest to those students of genetics who are interested in the economic aspects of inheritance in cattle. These four problems may be stated as: (1) the inheritance of milk yield, (2) the inheritance of the butterfat concentration in the milk, (3) the inheritance of the duration of time during which the milk flow is maintained, and (4) the inheritance of the degree and kind of fleshing.

Two methods of approaching these problems are possible. The first consists in analyzing the more or less complete records which are in existence. The second consists of making definite controlled matings to determine the inheritance of the desired characters. The Biological Laboratory of the Maine Agricultural Experiment Station is approaching these problems along both of these lines. The results herein described deal chiefly with the second mode of approach.

The definite, controlled matings to produce the animals necessary for the analysis of these problems were begun in 1913 under the direction of Dr. Raymond Pearl. At the beginning of the war in 1917 the author took over the direction of the work and the analysis of the accumulating data. All the credit for the inception and organization of the breeding experiments consequently belongs to Dr. Pearl. The manner of approaching the solution of the data are the author's own and he alone is responsible for the conclusions drawn.

In 1917 certain of the results of these matings on inheritance in milk production were presented in the Journal of Agricultural Research[2]. The material given herein represents the accumulations of data since that date.

### MILK PRODUCTION AS MEASURED BY AGE

It has been shown by the work of this laboratory that milk production for the four main dairy breeds changes in a definite manner with age. This change is described by logarithmic functions whose equation may be determined. When these logarithmic curves are compared it is found that the relative increase and decrease of the milk yield of the different ages is nearly the same for each of the three dairy breeds—Jersey, Guernsey and Holstein-Friesian. This consistency of the effect of age changes on the milk yields of the different breeds allows the correction of their milk yields and those of their crossbred offspring by the same set of correction factors determined as the mean for the three breeds Jersey, Guernsey and Holstein-Friesian. Whether or not the milk production of the Aberdeen Angus follows the same law as the dairy breeds is not known although there is a large amount of presumptive evidence that it does. In lack of final evidence all records for the milk yield of the Aberdeen Angus cows were corrected by the same set of corrections as those for the dairy breeds.

The age of two years has been chosen as the basis on which the records have been corrected. Thus if the crossbred daughter has lactation records at say two years, three years four months; and four years six months; the record

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[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 135.

[2] Gowen, John W. 1918. Studies in Inheritance of certain characters of crosses between Dairy and Beef Breeds of Cattle. In Journal Agr. Research, vol. XV, No. 1, p. 1–57.

for three years four months is corrected to the expected record at two years, and the four years six months record to the expected record at two years. These three records are then summed and the average taken. This average is the record used as the milk production of the crossbred. These average records have been used as the measure of the cow's milk production because the work of Gaven[3] on British Holsteins and of this laboratory on the Jersey[4] has shown that the mean of two or more lactations is a better measure of a cow's capacity as a milk producer than is the record of one lactation. These records have been brought up to the date of May 1, 1920.

The milk yields for the dams of the crossbreds are obtained in a similar manner to those for their crossbred daughters.

### THE SIRES' POTENTIAL MILK PRODUCTION

The records for the sires Taurus Creamelle Hengerveld and Lakeland's Poet are obtained as follows. The records of all daughters of these sires from dams of their own breeding are obtained in a similar manner to that described for the crossbred females. These records showing the milk production of each daughter of a given sire, other than crossbred, are then summed and the mean taken. This mean is used as the sire's potential transmitting ability. The measure used is consequently the progeny performance test for the hereditary composition of the sire for milk production.

The composition for milk production transmission of the Holstein-Friesian bull, Delva's University De Kol, where no pure offspring are available is that of Taurus Creamelle Hengerveld. It is realized that the use of this milk production to describe the transmitting ability of Delva's University De Kol is open to serious criticism. No purebred offspring are available from which an accurate test of this bull's composition could be made. In view of this contingency two fairly strong arguments support the choice of Taurus Creamelle Hengerveld's transmitting ability to represent that of Delva's University De Kol. The bulls are of the same breed. The dam of Delva's University De Kol, Delva Johanna De Kol had a milk yield closely resembling that of Taurus Creamelle Hengerveld's potential yield, as may be seen by a comparison of the sire's curve in the second graph of Figure 14, with the dam's curves of the third graph for the same figure.

Likewise the daughters of the sire of Delva's University De Kol, Johanna Lad Manor De Kol 41913 were similar in milk production to those of Taurus Creamelle Hengerveld. These facts consequently make it seem altogether probable that the milk transmitting capacity of Delva's University De Kol is correctly represented.

The transmitting qualities of Kayan, the Aberdeen Angus bull, were taken as the mean corrected two years old records of the purebred herd of Aberdeen Angus cows. The use of this record for Kayan can only be defended on purely *a priori* grounds. Until such time as his daughters come in milk this procedure will be subject to criticism. Kayan's pedigree does lead to the belief that his milk transmitting record has been correctly represented in the diagrams illustrating these data.

Figure 14, first graph, shows the milk record of Crossbred No. 1 on a monthly basis corrected to the age of two years. This record is shown by the solid line (————————). The mating to produce this crossbred was a Jersey bull, Lakeland's Poet 102603, bred to a Holstein-Friesian cow, Pauline Posch 81048. The milk production of the dam Pauline Posch, on a monthly basis corrected to the two year age expectation, is given by the dotted line (. . . . . ). The expected poten-

[3] Gavin, William. 1913. Studies in Milk Records. On the Accuracy of Estimating a cow's milking capability by her First Lactation Yield. In Jour. Agr. Sci., vol. 5, pt. 4, pp. 377–390.

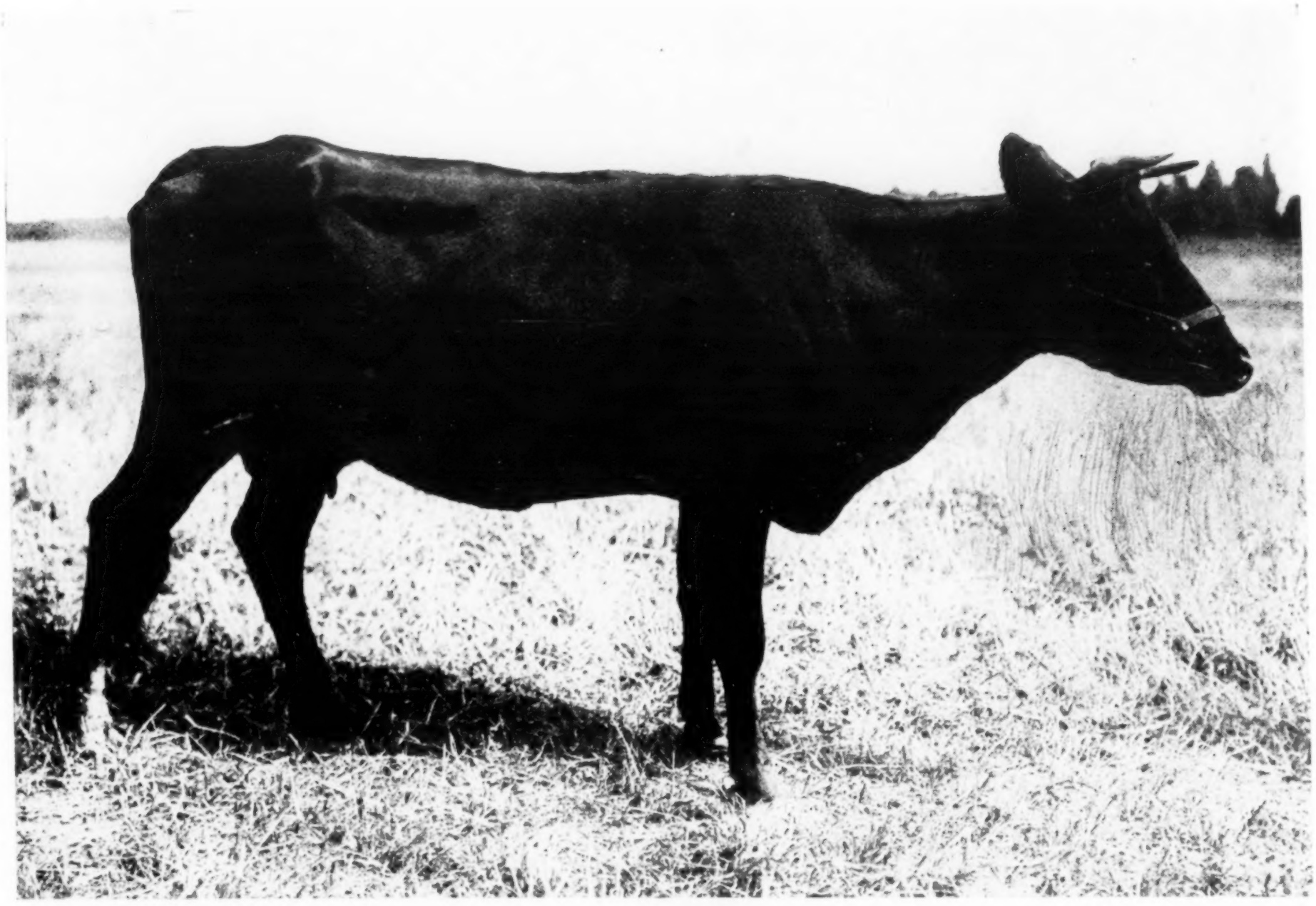
[4] Gowen, John W. 1920. Studies in Milk Secretion. V. On the Variation and Correlations of Milk Secretion with Age. In Genetics, vol. V, no. II, pp. 111–188.

**JERSEY SIRE OF CROSSBRED NO. 1**

Lakelands Poet, 102603, bred to the Holstein-Friesian dam shown below produced the crossbred cow shown on the opposite page. This sire transmitted the quality of low milk yield. (Fig. 5.)

**HOLSTEIN-FRIESIAN DAM OF CROSSBRED NO. 1**

Pauline Posch, 81048, whose milk yield was uniformly higher than that of her crossbred daughter. Her record is represented by the dotted line in the top graph of Fig. 14. (Fig. 6.)



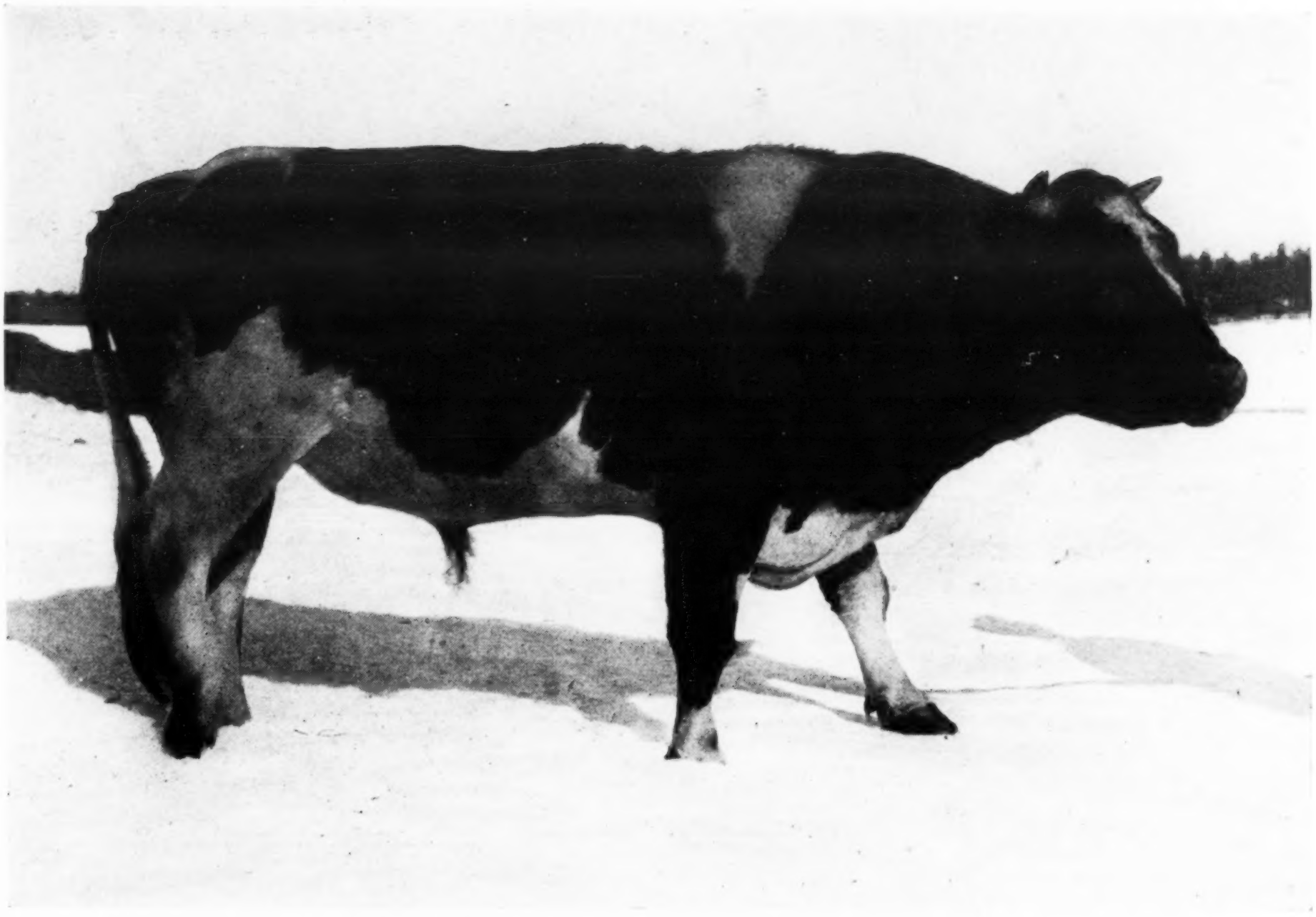
**CROSSBRED NO. 1**

This crossbred is from the Jersey and Holstein-Friesian parents shown on the opposite page. It will be noted that the shape of the nose and body of the crossbred resemble the Holstein-Friesian parent, while the size of body and udder resemble the Jersey parent. In the top graph of Fig. 14, compare the records of milk production of the offspring with that of her parents as explained in the text on page 301. (Fig. 7.)

tial milk production of the Jersey sire is given as a dot and dash line (—·—·—). The milk production of the crossbred clearly follows that for the sire's expectation. The milk production of the Holstein-Friesian dam follows a course much higher than does that of the crossbred daughter. The daughter may therefore be said to have only the inheritance of the low milk producing breed. In view of what follows in these curves this result is somewhat surprising. The result cannot, however, be a mistake, because the crossbred daughter's milk production is based on four lactations; the milk production of the Holstein-Friesian dam is based on 11 lactations, and potential milk production of the sire is based on four daughters having two lactations each. These facts make it seem probable that the milk production for the matings are somatically as represented in the top drawing of Figure 14. The photographs of the animals comprising this mating are shown in Figs. 5, 6 and 7.

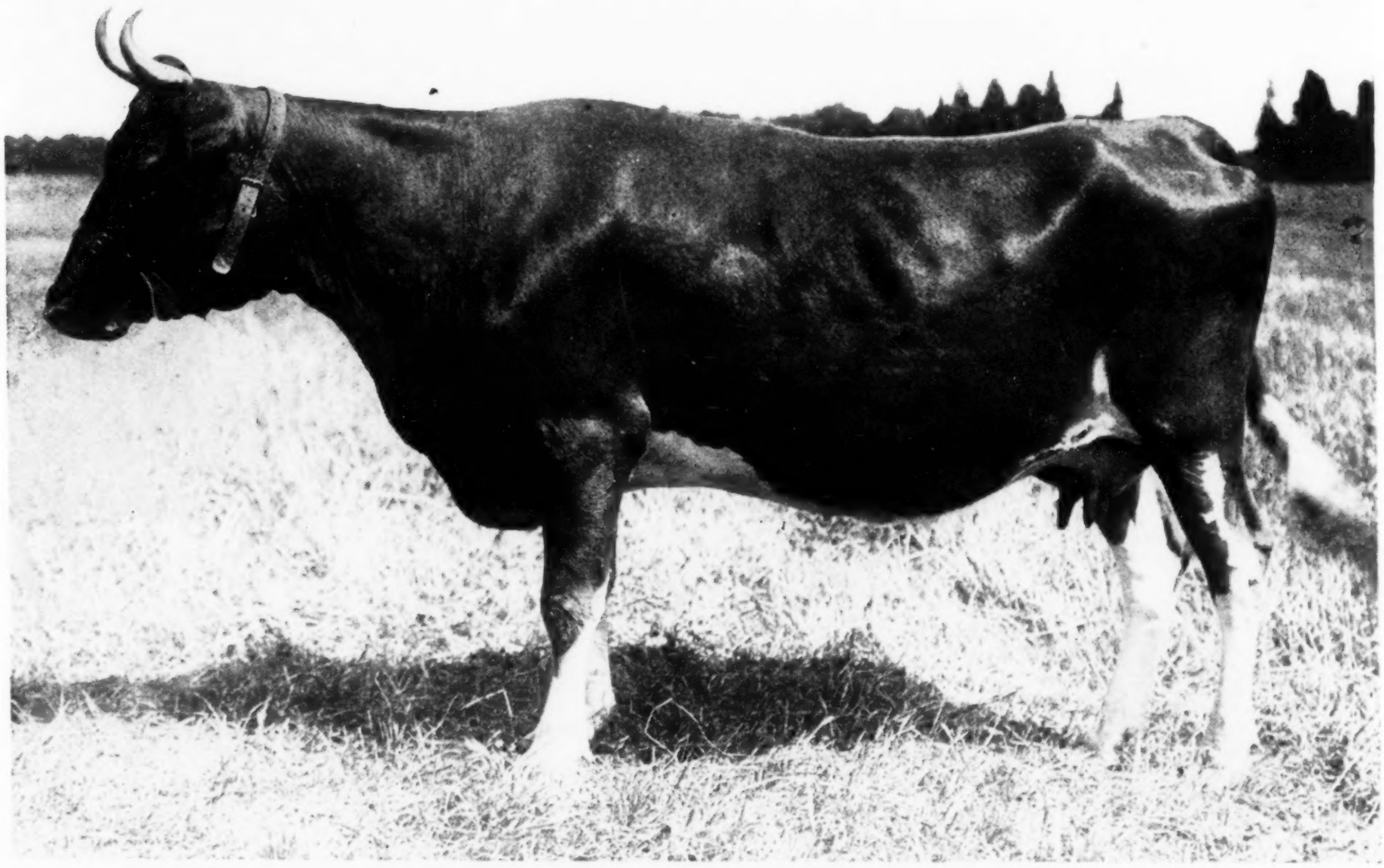
EIGHT MONTHS LACTATION PERIOD

The duration of milk production for most cows of the leading dairy breeds depends largely on the will of the herdsman as to when the lactation will close. Such being the case it is desirable to have for the whole lactation a time interval over which to compare the milk yield of one cow with that of another. For convenience this time interval has been chosen as eight months. Such a duration of time will allow the inclusion of the records of the Aberdeen Angus cows and their crossbreds where one of the main causes of their low milk yield



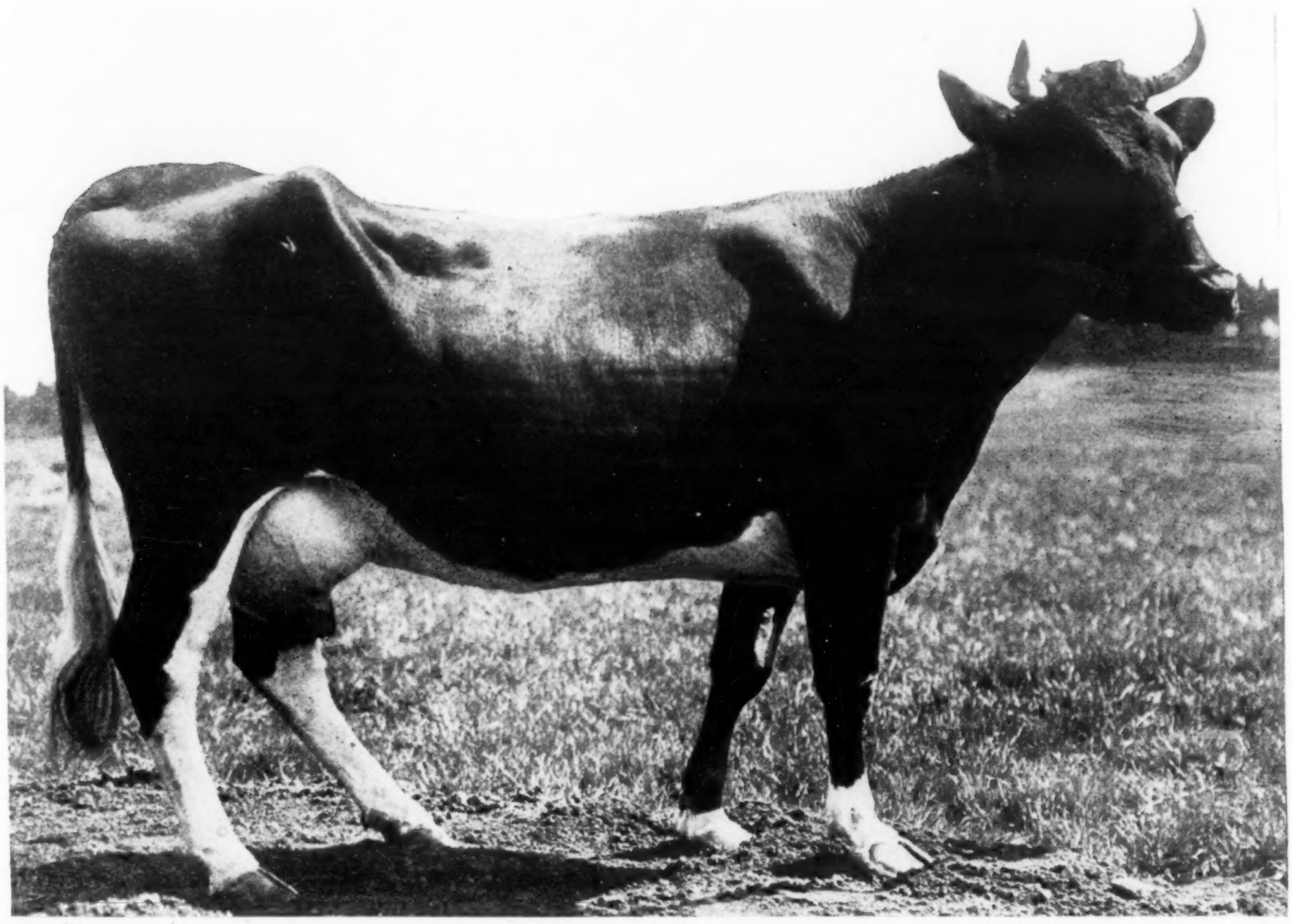
**HOLSTEIN-FRIESIAN SIRE OF CROSSBRED NO. 12**

Taurus Creamelle Hengerveld, whose potential high milk yielding quality was transmitted to the crossbred. (Fig. 8.)



**GUERNSEY DAM OF CROSSBRED NO. 12**

The eight months' lactation record of this cow, College Gem, was 2673.8 pounds of milk, while that of her daughter, Crossbred No. 12, was 5367.3 pounds. It is thus seen that the crossbred follows more closely the potential high yielding quality of the male parent. (Fig. 9.)



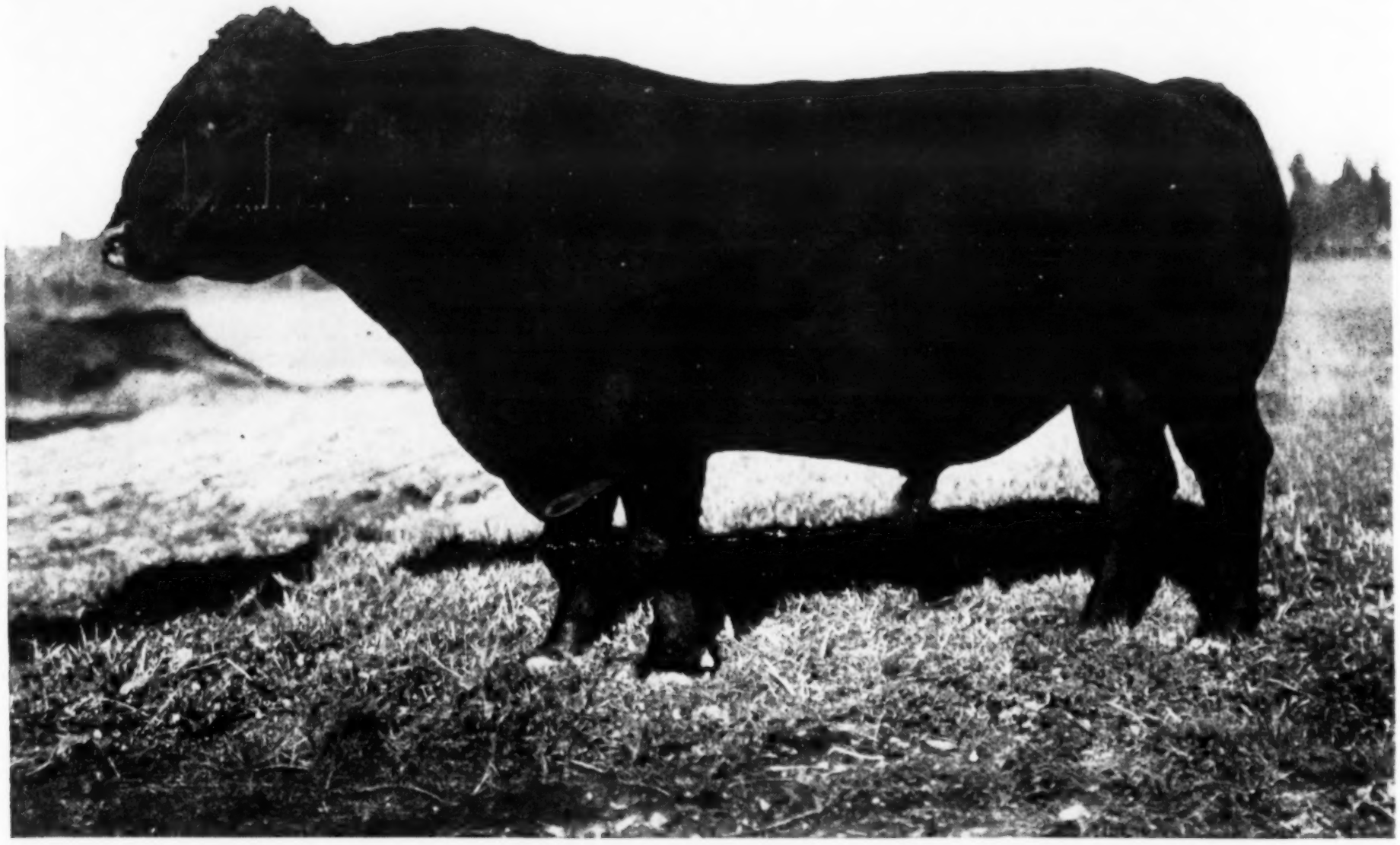
**CROSSBRED NO. 12**

Offspring of the Holstein-Friesian and Guernsey parents shown on the opposite page. The general conformation of the body shows many points typical of the Guernsey mother; the size of the udder resembles the Holstein-Friesian parent. See the fourth graph in Fig. 14 for comparison of this crossbred's milk yielding quality with that of her parents. While this crossbred's milk record clearly follows the high milking parent, there is a tendency for the crossbred to be intermediate between the two lines. (Fig. 10.)

may be duration of lactation as well as the daily quantity of milk yield.

For the eight months lactation period, Crossbred No. 1 produced on the average 4,161.3 pounds of milk. Her dam, Pauline Posch, produced 6026.3 pounds of milk and her sire, Lakeland's Poet's, potential milk yield was 3919.0 pounds. Comparatively speaking, therefore, the crossbred cow was intermediate between the two parents being 1865.0 pounds of milk less than the high line and 242.3 pounds more than the low line. The crossbred was consequently 7.7 times as near the low line of production as she was the high line. If we analyze the graph for her monthly milk yields as shown in Figure 14 it is found that the Crossbred's milk yield follows almost identically that of the low parent, Lakeland's Poet. Only in the tenth month does it show any appreciable deviation from this low production. In this deviation extraneous causes enter, as explained above, in that the lactations are not of equal duration and the record of a cow is determined for whole monthly records only where these are available. This, of course, has the effect of making the end of the lactation record less reliable than its beginning. For the tenth and eleventh month, the record of Crossbred No. 1 resembles the high parent although probably the resemblance is not significant.

The second graph of Figure 14 shows the milk production of Crossbred No. 2 on a monthly basis. The significance of the three different lines is the same as that for the first graph of Fig. 14. Crossbred No. 2's record is unfortunately based on only one lactation record. The record for Canada's Creusa

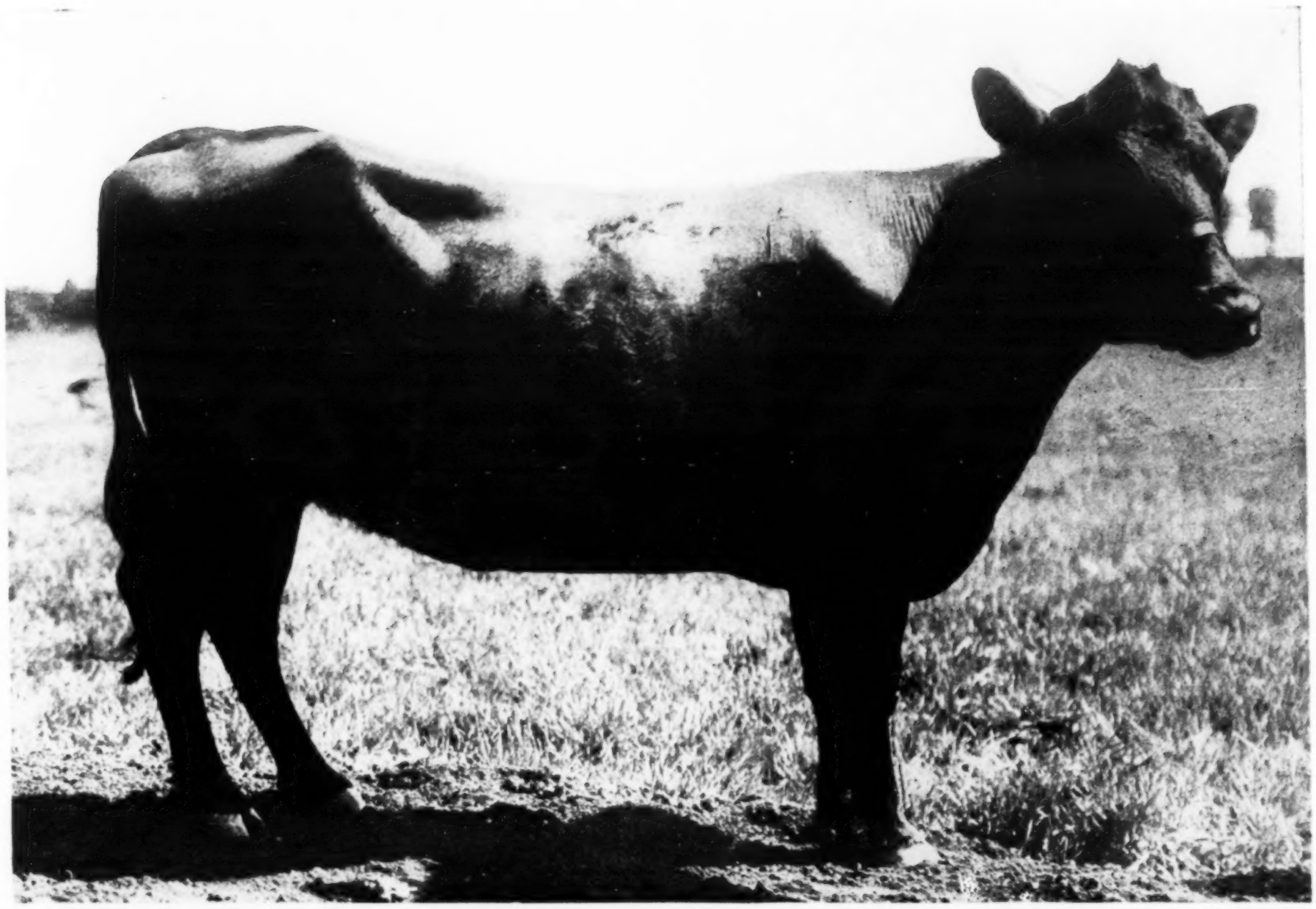


**KAYAN, THE ABERDEEN ANGUS SIRE OF CROSSBRED NO. 16**

For an eight months' lactation period, the potential milk yield of this sire was 1661.5 pounds; the production of the dam shown below was 3581.5 pounds, and the crossbred's production was 3264.1 pounds. Thus the crossbred resembles the high producing parent 5.1 times as closely in its milk yield as it does the low producing parent. (Fig. 11.)

**COLLEGE RUTH, THE JERSEY DAM OF CROSSBRED NO. 16**

As shown by the figures above the high milk yielding quality of this parent was transmitted to the crossbred. (Fig. 12.)



**CROSSBRED NO. 16**

The product of the Angus and Jersey parents shown on the opposite page. The polled head and heavy fleshing of the fore-quarters are characteristic features of such a cross. For the whole lactation period, this crossbred's milk production was clearly intermediate between that of the high producing parent and the lower producing parent. Compare the records as shown by the last graph in Fig. 14 (Fig. 13.)

is based on six lactation records. The record for the sire, Delva's University De Kol, is that of the Holstein-Friesian milk production for this herd at two years as previously described. The curve for the milk production of Crossbred No. 2 clearly follows that of the Holstein-Friesian, or the high milk producing breed. The continuation of the lactation from the eighth month on for the Crossbred No. 2 would clearly follow the milk yield of the Holstein-Friesian parent. Unfortunately this record is not available as the cow on the tuberculin test showed a temperature, was judged tubercular and killed. Her autopsy did not however show any lesions which were noticeable. Her record is therefore representative, so far as it goes. The photograph of this cow is shown in the following paper of this series, in the next issue of this Journal.

## PERIOD OF LOWEST MILK YIELD

Considering the record of the different months individually it is seen that the milk yield of the first four months is more nearly intermediate than is the milk yield of the succeeding months. This more nearly intermediate condition or approach of the crossbred cows to the low line is somewhat typical of the other crosses. What explanation may be found for its occurrence is obscure in the light of our present knowledge. It is known that the time of year when a cow freshens may increase or reduce the milk yield somewhat. The times of year favoring the lowest milk yield are the months July, August, and September in this climate. As Crossbred No. 2 calved in August this may explain her not reaching the production of the high parent during these first four months. Before this

explanation can be finally accepted, however, more work on the relation of the different monthly lactations needs to be done.

The eight months milk production of Crossbred No. 2 was 5337.2 pounds. The milk yield of Canada's Creusa was 3608.5 pounds and that for Delva's University De Kol was 5548.9 pounds. In other words Crossbred No. 2 was within 221.7 pounds of milk of her high producing parent and was 1728.7 pounds of milk more than her low producing parent. The Crossbred No. 2 was, therefore, 7.8 times as close to the high line as she was to the low line. This fact in connection with the milk record of Crossbred No. 1 suggests that segregation of milk producing factors having dominance has taken place in these crosses.

The milk production of Crossbred No. 11, shown as the third graph of Fig. 14, is clearly intermediate between that of her dam Delva Johanna De Kol 146774 and her sire Lakeland's Poet 102603 for the first four months of lactation. From this time on this cow follows closely the milk production of the high milking parent Delva Johanna De Kol. The crossbred record consisted of the average of three corrected records; that of the Holstein-Friesian dam consisted of the average of eight corrected records; that of the sire consists of the average of four pure bred daughters for two lactations each. The photographs of this mating are given in the succeeding paper of this series.

The records of Crossbred No. 11 all commenced in the months of July and August. As previously pointed out the calving in these months is most unfavorable to a high record, so unfavorable as to make a difference of 600 pounds of milk in the eight months milk record of Jersey cows. Whether this explanation will account for the milk yield of Crossbred No. 11 being intermediate between that of the high and low lines during the first four months of lactation is not known; although it is highly probable that the time of calving did have some effect toward reducing the yield. With the dam this time of calving effect on the milk yield of the lactation is approximately averaged as she calved three times in the month of April, twice in the month of March, and once in the months July, June and May. Likewise the record for Lakeland's Poet is approximately averaged although favoring somewhat the high side of the milk production as his daughters calved three times in April, twice in February and once in May, November and January.

The eight months milk yield of Crossbred No. 11 was 4984.8 pounds, that of Delva Johanna De Kol was 5375.8 pounds, and that of Lakeland's Poet was 3919.0 pounds. Crossbred No. 11 w s consequently 391.0 pounds of milk below the milk yield of her high milk line, ancestrally speaking, and 1065.8 pounds of milk above the low milk line. The crossbred cow is consequently 2.7 times as near the high line of milk yield as she is near the low line of milk yield.

The fourth graph of Fig. 14 shows the milk yield of Crossbred No. 12 and her two parents. The photographs of this crossbred and her purebred parents are seen in Figs. 8, 9 and 10. This crossbred's milk record clearly follows the high milking parent throughout most of the course of the lactation. As in the preceding cross there is some slight indication that the crossbred tends to be intermediate between the two lines for the first few months of lactation. Her calving dates were on the whole such as to neutralize any time of year effect on milk yield. Likewise the records of the sire and dam show little of this effect.

The eight months lactation record of Crossbred No. 12 was 5367.3 pounds; the record of her Guernsey dam, College Gem was 2693.5 pounds; the potential record of her Holstein-Friesian sire, Taurus Creamelle Hengerveld, 5548.9. Crossbred No. 12 is consequently 2693.5 pounds of milk more than her Guernsey dam and 181.6 pounds of milk less than her Holstein-Friesian sire or her high parent. The

crossbred's milk yield consequently resembles that of the high line 14.8 times as closely as it does the low line.

The fifth graph in Fig. 14 represents the milk production of Crossbred No. 15 and her parents, Lakeland's Poet, Jersey; and Hearthbloom, Aberdeen Angus. The photographs of the animals composing this mating are shown in the succeeding paper of this series. The graph for Crossbred No. 15's milk production shows the same intermediate yield as is shown in the first few months of lactation by the other preceding crossbreds.

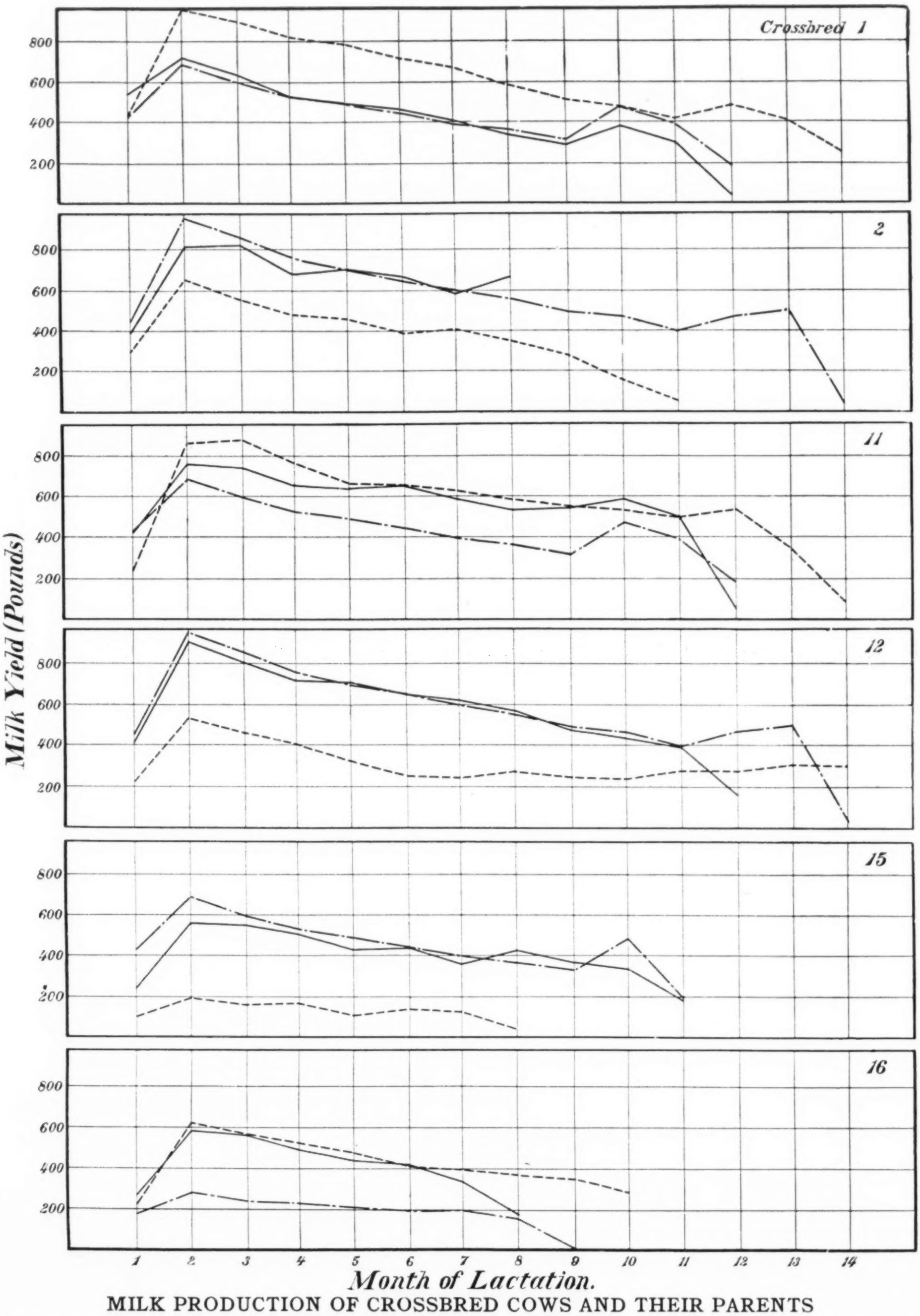
The time of year for the commencement of the lactation has been favorable to a medium to high yield for this crossbred as the months of calving were December (twice) and January (once). The total milk for the eight months period was 3493.0 pounds. The milk yield for the Aberdeen Angus mother was 1065.9 pounds and for the Jersey sire 3919.0 pounds. The crossbred cow was consequently 426.0 pounds of milk less than her high milk producing parent and 2427.1 pounds above her low milk producing parent. From these facts it is seen that this crossbred cow is 5.7 times as near the milk yield of her high milk yielding parent as she is her low yielding parent.

The last graph in Fig. 14 gives the milk yields of Crossbred No. 16, her Jersey dam, College Ruth and her Aberdeen Angus sire, Kayan. The photographs of the animals comprising this mating are shown in Figs. 11, 12 and 13. This cow proved very difficult to settle for her second lactation. She has in fact lost nearly one year due to this cause. The milk production was somewhat higher relatively for the second lactation than for the first lactation, although it did not continue longer in its duration.

The milk production of Crossbred No. 16 is clearly intermediate between that of the high milk producing parent and the lower milk producing parent. The resemblance of the crossbred's milk yield to the high line is very close for the first six months of lactation. From the sixth month to the end of the lactation the crossbred cow declined rapidly in her milk flow.

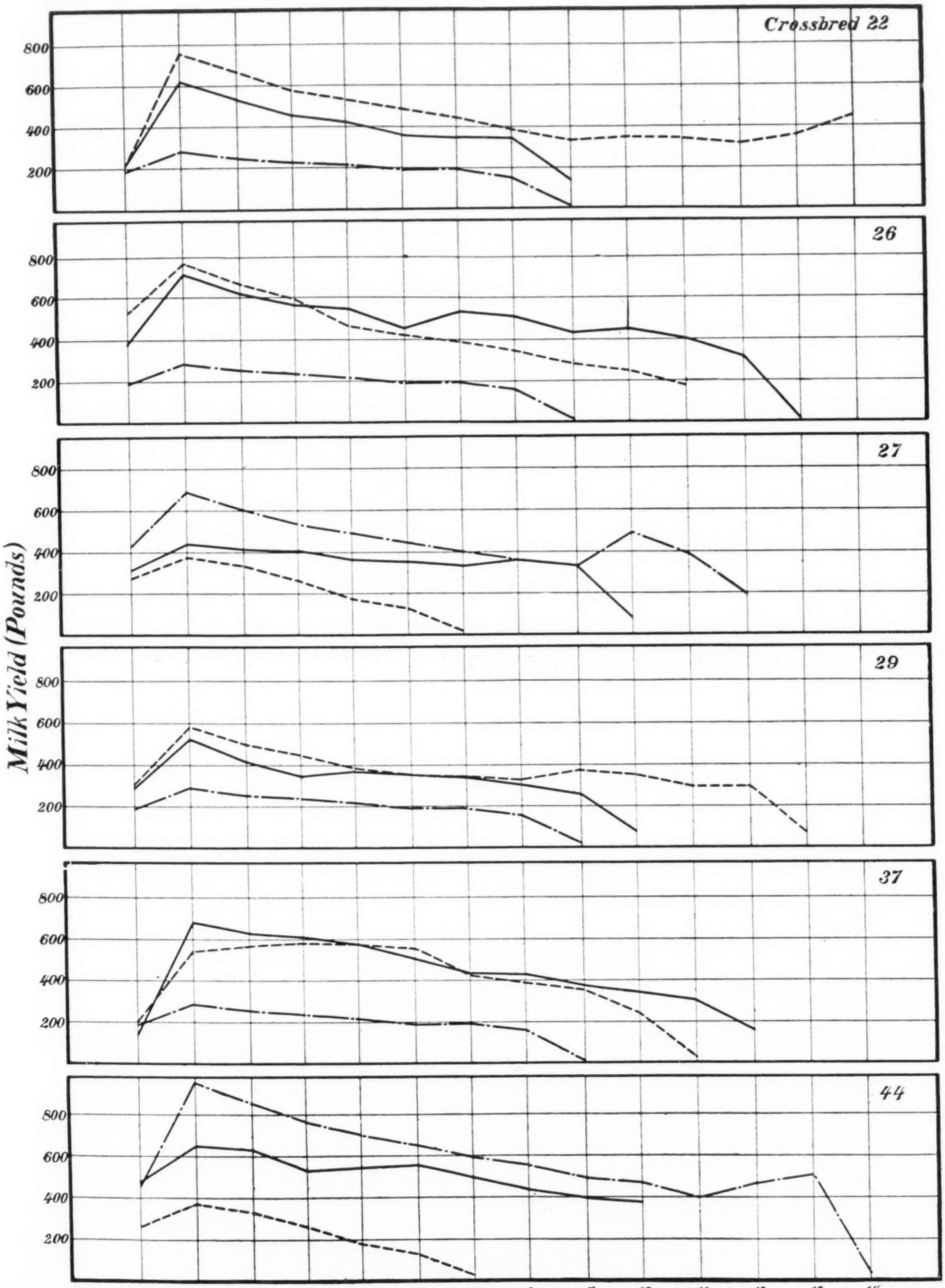
Considering the whole of the eight months lactation Crossbred No. 16 gave 3264.1 pounds of milk. Her pure bred Jersey parent gave 3581.5 pounds for the same period. The potential milk production of the sire was 1661.5 pounds. It is easily seen from the diagram that the duration of the milk flow plays some part in this crossbred's milk yield. Thus up to the seventh month of lactation the crossbred's milk production was 2746.1 pounds as against the milk production of her high producing dam of 2822.7 pounds and of the low producing line of 1312.2 pounds. The difference between the high milk producing line and the crossbred's milk production for the eight months period was 317.4 pounds. The difference of the milk production of the crossbred's milk yield and the low potential milk production of her sire is 1602.6 pounds for the eight months period. The crossbred consequently resembles the high producing parent 5.1 times as closely in its milk yield as it does the low producing parent. If we compare the milk yields for the first six months of lactation we find that the resemblance of the crossbred to the high line milk yields becomes 18.7 times as close as to the low line milk yield.

Fig. 15 represents the milk yield of six of the other later crossbred cows taken in the order of their birth. The milk yield for the first lactation is complete for the first five crossbreds. Four months of the second lactation are available for Crossbred No. 22; six months for Crossbred No. 26; a complete second lactation for Crossbred No. 27; two months for Crossbred No. 29; and three months for Crossbred No. 37. In view of the fact mentioned at the beginning of this paper that the reliability of a cow's record increased as the number of lactations increases, it follows that without doubt the milk records of these crossbreds shown in Fig. 15 will be subject to some modification as the number of lactations increase.




**MILK PRODUCTION OF CROSSBRED COWS AND THEIR PARENTS**

These graphs represent the milk production, by months and pounds, of crossbred cows Nos. 1 to 16 and their parents. The number of the crossbred is in the upper right hand corner of each set of graphs. The crossbred is represented by the solid line in each case, the dam by the dotted line, and the sire by the dot-and-dash line. (Fig. 14.)




**MILK PRODUCTION OF CROSSBRED COWS AND THEIR PARENTS**

Showing the records of Crossbreds Nos. 22 to 44. The solid lines represent the crossbreds, the dotted lines for the dams, and the dot-and-dash lines for the sires. (Fig. 15.)

Crossbred No. 22 was the result of the mating of Kayan, Aberdeen Angus bull, to College Creusa, Guernsey cow. The corrected monthly milk yield for the sire, dam and resulting crossbred is shown in the first graph of Fig. 15. The milk record of this crossbred cow has had some difficulties. In her second lactation this cow gave birth to a calf at 245 days which did not live. At that time her udder had only just begun to make up to its coming lactation. Consequently Crossbred No. 22 produced no milk for this lactation. The lactations which have been perfectly normal and which are used to determine her milk production are those commencing at two years and three months and at three years and ten months. The abortion which came in between these dates is thought to have come from an accident in the yard during the time the cows were out for exercise and not from contagious abortion of cattle. This supposition is made somewhat stronger by the fact that only rare cases of this kind have appeared in the herd and then were some time apart.

From the upper graph of Fig. 15 it is clearly seen that the milk yield of Crossbred No. 22 is intermediate between that of her high and her low producing line ancestrally speaking. The lactation for each month is however nearer the milk yield of the high parent than it is near the low parent. Thus during the first eight months, the milk yield of Crossbred No. 22 was 3320.8 pounds, her high producing dam, College Creusa produced 4057.9 pounds and her low producing sire, Kayan's, potential production was 1661.5 pounds. Crossbred No. 22 was consequently 737.1 pounds of milk less than her high producing parent and 1659.3 pounds more in milk yield than her low producing parent or Crossbred No. 22 favored the milk yield of the high line 2.3 times as closely as she did the milk yield of the low line.

The record for Crossbred No. 26 together with that of her parent is shown in the second graph of Fig. 15. The mating which produced this cow was Kayan, Aberdeen Angus bull, bred to Creusa of Orono 3d, Guernsey cow. The milk yield of this crossbred cow is intermediate between that of her high and low parents for the first four months of lactation. After the fourth month the milk yield of the high parent is surpassed by that of the crossbred. As will be noted from the other preceding graphs this is the first instance where the crossbred has actually surpassed the milk yield of her two parents. The milk yield of Crossbred No. 26 for the eight months period is 4303.5 pounds, that for Creusa of Orono 3d is 4156.1 pounds and for Kayan 1661.5 pounds. The crossbred cow produced 147.4 pounds more milk than her purebred Guernsey parent and 2642.0 pounds more than her sire's potential milk yield. Crossbred No. 26 consequently resembles the high line of production 17.9 times as closely as she does the low line of production. Crossbred No. 26 produced this amount of milk when calving at one of the most unfavorable times of the year, September, whereas the lactation of her parents came in months which were favorable to an average yield.

Crossbred No. 27 was the result of a mating of the Jersey bull, Lakeland's Poet, to the Aberdeen Angus cow, Orono Madge. The milk yield of Crossbred No. 27 is shown in the third graph of Fig. 15. For the first four months of lactation the milk production of this cow is lower than that of the intermediate between the high and the low milk producing lines of her ancestry. From the fourth month of lactation this crossbred's milk production continues to constantly approach the milk production of her high line ancestry. In describing the milk production of this cow it might be said it was the persistence with which this cow maintained her milk production month after month rather than the large quantity of her milk yield at any one time that causes her to be intermediate between the high and low lines of production. In this connection it should be said that this crossbred cow commenced her lactations in two

months quite unfavorable to a high milk flow for the subsequent eight months of production.

The milk yield for the eight months period was 2995.7 pounds for Crossbred No. 27; 3919.0 pounds for Lakeland's Poet, her purebred Jersey sire; and 1569.3 pounds for Orono Madge, her purebred Aberdeen Angus dam. The crossbred cow's milk production was consequently 923.3 pounds less than her high producing sire and 1426.4 pounds more than her low producing dam. The crossbred cow resembled the high producing parent 1.5 times as closely for the eight months period as she did her low producing dam.

The fourth graph of Fig.15 shows the monthly milk yield of Crossbred No. 29 and her purebred parents. Crossbred No. 29 is the result of a cross between the Aberdeen Angus bull, Kayan, and the Guernsey cow, Creusa's Lady. The milk yield of the crossbred cow is intermediate between that of her high milk producing parent and her low milk producing parent for the first four months of lactation. After the fourth month Crossbred No. 29 follows the high line of production quite closely until the last two months of her lactation when she approaches the intermediate again.

For the eight months lactation period Crossbred No. 29 produced 2909.7 pounds of milk; her purebred Guernsey parent produced 3271.5 pounds and her Aberdeen Angus sire s potential milk yield was 1661.5 pounds. The difference of the crossbred's milk yield and that of her Guernsey mother was 361.8 pounds. The difference from the potential milk yield of her sire was 1248.2 pounds. The crossbred cow consequently resembled her high producing line 3.4 times as closely as she did her low producing line.

Crossbred No. 37 was the result of mating Kayan, Aberdeen Angus, to Dot Alaska, Ayrshire. The milk production of this crossbred exceeded that of her high line Ayrshire dam during the first four months of lactation. After that time the milk yield was approximately equal. During the first eight months of lactation Crossbred No. 37 produced 3984.7 pounds of milk or 129.0 pounds more than the production of her purebred Ayrshire dam. The potential milk production of Kayan was 1661.5, pounds, or Crossbred No. 37, his offspring, produced 2323.2 pounds more milk than this potential yield. The crossbred cow was consequently 18 times as close to the high line of production as she was to the low line of production. The time of calving during the year was favorable to medium to high yield records.

Crossbred No. 44 was the result of crossing the Holstein-Friesian bull, Taurus Creamelle Hengerveld on to the Aberdeen Angus cow, Orono Madge. The bottom graph of Fig. 15 shows the milk production of the two parents and the crossbred. Too much weight should not be given this record as the first lactation record is as yet not even complete. It is to be expected that subsequent lactation records may modify considerably the record of this crossbred cow from what it is as it now stands. For the first four months of lactation the crossbred cow occupies a strictly intermediate position between the high and low lines of production. After the fourth month the lactation record approaches the high line of production. The milk yield for the eight months period was 4306.3 pounds for Crossbred No. 44; 5548.9 pounds for the potential milk yield of the pure bred Holstein-Friesian sire; and 1569.3 pounds for the Aberdeen Angus dam. The crossbred cow was 2737.0 pounds more milk than its low producing dam and 1242.6 pounds less than its high line sire. The crossbred resembles the high line of production 2.2 times as closely as it does the low line of production.

## DOMINANCE OF MILK PRODUCING FACTORS

If the substance of the preceding pages is recapitulated it is found that Crossbred No. 1 resembles her low producing parent 7.7 times as closely as she does the high producing parent. The other eleven crossbreds resemble

the high producing line of milk production from 1.5 to 18.0 times as closely as they do the low line of milk production. If this paralleling of the high line production is averaged, it is found that the crossbreds resemble the high line of production 4.76 times as closely as they do the low line. These facts argue for the transmission of milk production by factors which show partial dominance. It would not seem that they argued for increased vigor of heterosis only because of the case of Crossbred No. 1, where the low line milk yield was definitely transmitted instead of the high yield. In fact it would appear that this crossbred is more likely to be a segregate of low milking factors from the high milking factors carried by her dam.

Three levels of milk production are crossed in these experiments. The Aberdeen Angus cattle constitute the lowest level, the Jersey, Guernsey and Ayrshire cattle averaging about the same in milk yield constitute the intermediate level of production and the Holstein-Friesian cattle having the highest yield represent the highest level of production. It is of some interest to compare the results of crossing the different levels. If we omit the result of Crossbred No. 1 it is found that the Holstein-Friesian cows or bulls mated to the second group of cows or bulls (Jersey, Guernsey, or Ayrshire) produced three offspring who are 8.43 times as near the milk production of the high level on the average as they were the low line of production.

The only cross involving the Holstein-Friesian and Aberdeen Angus, Crossbred No. 44, was 2.2 times as close to the high line of production as she was close to the low line of her parent's milk yield.

It is of interest to note in this connection that Crossbred No. 44's milk yield resembles closely the milk yield of the intermediate group (Jersey, Guernsey and Ayrshire) of these experiments.

The crosses involving the second level of milk production (Jersey, Guernsey and Ayrshire) mated to the third group Aberdeen Angus, had crossbred offspring resembling the high line 7.7 times as closely as they did the low line of production. This figure compares favorably with that of the Holstein-Friesian x Jersey crosses.

If the crosses are compared to determine what effect the high line on the sire's side of the cross may have in comparison with the effect produced by the high line being on the dam's side of the cross it is found that the results in the three lines are contradictory. When the Holstein-Friesian sires were mated to second class dams, Guernseys, the offspring resembled the high line 11.3 times as closely as she did the low line. When the Jersey sire, second class, was mated to the Holstein-Friesian cows, highest class, the milk production once resembled the high class 2.7 to 1, and once the low line 7.7 to 1. The crosses involving the highest milk line, Holstein-Friesian bull, to the lowest milking line Aberdeen Angus cow produced an offspring resembling the high line 2.2 times as closely as the low line. The crosses of the second level in milk production to the third level show that when the higher level is on the sire's side the daughters resembled the high line 3.6 times as closely as they do the low line. When the higher level is on the dam's side the daughters resembled the high line 9.34 times as closely as they did the low line. It seems doubtful from these results if there are modifying sex linked factors present.

## MENDELIAN TRANSMISSION OF MILK YIELD

The literature on this subject is surprisingly meag r considering the economic importance of milk and its products. Of those studies which are available that made by Wilson[5] is one of the earliest. This paper is devoted to showing that with such a breed as the red Dannish there may be wide

[5] Wilson, James. 1911. The Inheritance of Milk Yield in Cattle. In Sci. Proc. Roy. Dublin Soc. Vol. 13, pp. 89–112.

difference between the milk yield of the daughter and the dam,—that is these differences do not always blend gradually, in fact as a rule they progress by wide steps. Further it is attempted to show that the sires in the red Dannish breed appear to be differentiated into those whose daughters are all low producers; those whose daughters may be low producers, medium producers, and high producers; and thirdly those whose daughters are all high producers. The data to support these conclusions are admittedly fragmentary and open to several criticisms. It is however held to show that milk yield is transmitted in mendelian fashion with the heterozygote intermediate between the pure forms.

The manner of grouping the data and its correction for age, etc., would seem to more or less force this conclusion. It does therefore offer no further critical information to differentiate between the transmission of milk yield by factors showing partial dominance as was apparently the case in our experiment and any other hypothesis.

Two practical experiments carried on by breeders in England are of particular interest as their crosses parallel some of those in these experiments. The object of the experiments was to cross the Jersey with the Aberdeen-Angus and to fix in the resulting offspring the hardiness of the Angus with the milk yield of the Jersey. The original crosses were made Aberdeen-Angus bull to Jersey cows. Although records were kept, no figures are cited in the paper[6] on this herd. The qualitative statement is, however, made that the $F_1$ cows show a high yield of milk, ranking almost as high as their Jersey dams.

In another section of England a similar cross was made by another breeder with the same objects in view. This breeder, Mr. Stevens,[7] makes a similar statement in regard to the milk yield of the $F_1$ cows.

Kildee and McCandlish,[8] record a similar experiment which incidentally furnishes some data on the transmission of milk yield. They crossed scrub cattle whose milk yield averaged between 3300 and 3900 pounds to Holstein-Friesian sires. The resulting $F_1$ offspring averaged 5561.6 pounds of milk. Crosses to Guernsey and to Jersey bulls did not increase the $F_1$ average production over that of the scrubs, although one daughter of a Guernsey sire did nearly double her milk yield over that of her dam. No age correction was applied to these records. The length of lactation was also not strictly comparable between animals. Several bulls of each breed were used. Despite these handicaps the results indicate that there was a partial dominance for milk yield expressed in the $F_1$ offspring of the Holstein-Friesian sires. The case of the single exceptional offspring of one of the Guernsey sires can likewise be explained on this basis for it has been shown that within a breed wide differences between sires in their ability to transmit milk yield may occur.[9] Such differences of course argue for differences in the factors for transmitting milk yield within the breeds similar to those illustrated in the experiments previously described.

Another extensive experiment was begun for similar practical objects by

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[6] Parlour, W. Jersey-Angus Cattle. In Live Stock Jour. (London) 77 (1913) No. 2025, p. 85. Kuhlman, A. H. Jersey-Angus Cattle. In Jour. Heredity 5 (1915) No. 2, pp. 68–72.

[7] Stevens, H. D. E. Jersey-Angus Cattle. In Live Stock Jour. (London) 77 (1913) No. 2025, p. 132.

[8] Kildee, H. H. and McCandlish, A. C. 1916. Influence of Environment and Breeding in Increasing Dairy Production. Bul. 165. Iowa Agricultural Experiment Station, pp. 383–402.

[9] Pearl, Raymond, Gowen, John W., and Miner, John Rice. 1919. Studies in Milk Secretion. VII. Transmitting Qualities of Jersey Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat. Maine Agricultural Experiment Station. Annual Report for 1919, pp. 89–205.

Gowen, John W. 1919. Report of Progress on Animal Husbandry Investigations in 1919. Maine Agricultural Experiment Station. Annual Report for 1919, pp. 249–284.

Mr. Bowlker on the crossing of the Guernsey and Holstein-Friesian breeds of cattle. The results as analyzed by Castle[10] show that the milk yield for 31 $F_1$ heifers resembled that of the Holstein-Friesian parents 1.88 times as closely as it did the Guernsey parents in the first lactation. In the second lactation the resemblance of the milk yield of the $F_1$ crossbreds was 3.78 times as close to the Holstein-Friesian parents as it was to the Guernsey parents. Unfortunately these records are subject to some criticism perhaps the most serious of which is the fact that all records of a given group, parents or crossbreds, are lumped together and the average used instead of being subject to individual analysis. Such a lumping together would hide such results as that of the mating for Crossbred No. 1. Another criticism of more or less serious nature comes in the throwing together of milk records of animals of quite different ages without applying age corrections. Considering these disturbing features the results are on the whole quite similar to those presented in this paper.

In the light of these all too meager data the results of this paper would seem to be supported by those of the other investigations on this subject. Such being the case the conclusion seems sound that the inheritance of milk yield appears to show a partial dominance of the high milk yield to the low milk yield.

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[10] Castle, W. E. 1919. Inheritance of Quantity and Quality of Milk Production in Dairy Cattle. In Proc. Nat. Acad., Vol. 5, pp. 428–434.

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## OUR MOST SIGNIFICANT CROPS—OUR BOYS AND GIRLS

"War throws a spotlight of convincing clearness upon national defects. . . . We are beginning to suspect, if not to fully realize, that even more essential and fundamental to the integrity and permanency of a nation than scientific progress, political achievement, industrial development and economic accomplishment, are biologic soundness and fitness, the health of the people.

"This national asset, health, while the most essential, is at the present time the most endangered of all our natural resources.

"Shall we not provide as thorough and effective health care and physical education for the children of our country as we furnish for the young men in the army and navy?"

"What about the basic needs of the great draft army of the nation's children who must supply the human units of the citizenry of the next generation; who must bear the burden of civilization in peace and in war? What shall we do about the neglect of the children who hold the future of civilization in their immature lives?"

"The children of our country deserve as effective physical care as the livestock.

"The children are entitled, even in war times, to as careful attention and cultivation as the crops."

"Shall not the children, drafted by compulsory education into our schools, be assured of as skillful and satisfactory care as the soldiers in camp?"

"I wish you appreciated the children and youth of this republic. They make up, in possibilities, the finest generation of human beings the world has ever seen. They make you feel that even more than the great museums and monuments, more than great industrial plants and ships, more than great skyscrapers and cathedrals, they should be guarded and protected, cultivated and developed for America—for the World."—*From an address by Thomas D. Wood, M.D., Columbia University, New York.*

# HERITABLE CHARACTERS OF MAIZE

## V. ADHERENCE

J. H. KEMPTON

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ADHERENCE is a variation in which the leaves, bracts and inflorescences coalesce. Any or all of these organs may adhere to one another to a varying extent. In extreme cases the upper leaves and terminal inflorescences are so firmly compacted into a hardened mass that the parts can not be separated. In less extreme cases the adhering organs separate naturally with the pressure of the growing parts. Frequently the leaves and even husks adhere so firmly to other organs that they are ruptured by the force of the elongating plant or shoot and such plants have a characteristic ragged appearance.

In some cases the variation is exhibited in seedlings but unless the leaves of the young plants adhere so firmly as to prevent further growth, the plants recover and apparently grow normally until the ear bearing node is reached, at which stage their adherent nature is manifested again. (See Fig. 16.)

The firm union of the upper leaves prevents proper elongation, causing startling contortions of the confined culms. (See Fig. 18.) When the ear is included in the adhering mass the enclosing husks also are united and unless they are opened artificially the silks cannot be exserted.

In many cases the growing ear, held firmly at the upper end, is forced into contortions similar to those of the culm. (See Fig. 19.) This purely mechanical inhibition of elongation reduces the length of the affected internodes as well as the ear and where the variation is pronounced, seed rarely is obtained. The tassels of such plants are greatly altered, being compressed into a solid structure, never expanding into the familiar branched panicle. In such an adherent inflorescence pollen is shed only from the spikelets of the lower or outer branches and not even from these unless the inflorescence has been artificially liberated from the confining mass of sheaths and blades. In less extreme cases the tip of the central spike will be exserted naturally, producing a small quantity of pollen and it is from such plants as these that the variation is propagated most readily.

The glumes of the staminate spikelets often are reduced greatly in length and altered in appearance resembling the hardened glumes of the ear. Not infrequently they have been so reduced in length that the anthers protrude from the unopened spikelets. The firmly compacted male inflorescence with the altered glumes strongly suggests the cob of ear, but when such an inflorescence is sectioned there is no evidence of fasciation and the interior branches and central spike are found to have developed spikelets.

### BREEDING MUST ELIMINATE ADHERENT PLANTS

The undesirability and entire worthlessness of adherent plants needs no emphasis and the variation takes its place with the ever increasing list of detrimental recessive abnormalities which breeding must eliminate.

The adherent variation was found in the second generation of a hybrid between the Boone County white variety and brachytic.[1] Two plants of a brachytic progeny were crossed with two plants of an inbred strain of Boone. In each cross brachytic plants were used as the female parents. The plants of the first generations were all normal and of greatly increased vigor.

Several self-pollinated ears were obtained from both hybrids but only three

[1] Kempton, J. H. A Brachytic Variation in Maize. U. S. Dept. of Agr. Bull. 925. Feb. 1921.

**THREE MAIZE SEEDLINGS SHOWING THE ADHERING EARLY LEAVES**

Adherence is an inherited variation in which the leaves, bracts and inflorescences unite or grow together. Any or all of these organs may adhere to one another to a varying extent. In some cases the variation is exhibited in seedlings. The mortality of such seedlings usually is high. Photograph natural size. (Fig. 16.)

TWO ADHERENT BRACHYTIC PLANTS

These plants produced no seed and the tassel branches unlike those of non-adherent sister plants are compacted into a hardened mass. (Fig. 17.)

progenies were grown the following season. These three progenies segregated in the expected manner, having approximately three normal plants to one brachytic but two of the progenies in addition produced plants with adherent organs. These two progenies were descended from the same first generation hybrid between brachytic and Boone. The adherent variation was not noticed until the plants had practically completed their growth at which time it was a striking abnormality. It was immediately apparent that there were no plants in which the brachytic character of the culm was combined with the adherent organs, all the adherent plants being found in the group of normal stature. The classification of the plants is given in Table I.

The percentage of adherent plants for the combined progenies, including normal and brachytic plants, is below that expected for a simple Mendelian character. This deficiency is probably due to the death rate in the seedling stages of the most extreme adherent plants. Since the variation was not found until the plants had reached maturity the counts were based on the survivors of the season. Subsequent generations have shown that the character appears in the seedling stage and that many of the badly affected plants die after the production of 3 or 4 leaves. The absence of brachytic adherent plants indicated a high linkage between normal stature and adherent but this hypothesis has not been sustained by the progenies.

Extreme cases of adherence are impossible to propagate and the progenies, especially those grown from self-pollinated seed, were from plants that expressed the character in an intermediate form. Difficulties also are encountered in satisfactorily bagging the

**AN ADHERENT PLANT PARTLY DISSECTED**

Showing the base of the compact tassel and the contorted stalk. The ear of this plant was not confined in the coalesced sheaths but the husks were firmly united and the prophyllum, fastened to the outer husks, has pulled apart as the ear lengthened. Photograph natural size. (Fig. 18.)

ears which, as the illustrations show, are often greatly twisted. This fact must be borne in mind in considering the results obtained with the progeny of adherent plants. The classification of the plants of the progenies of the adherent variation is shown in Table II.

Three progenies were grown from self-pollinated adherent plants, and two of them produced six apparently normal plants in a population of 68, the others being adherent. These may have resulted from faulty technique in pollinating or perhaps a failure to develop the character to a noticeable degree. This latter hypothesis would seem the more plausible in view of the large number of normal plants produced by crosses between adherent plants, and the fact that the normal plants were no more vigorous than their adherent sisters. Self-pollinated ears have been obtained from these normal individuals, and they will be tested next season.

### ADHERENCE NOT LINKED WITH NORMAL STATURE

Of the progenies grown from self-pollinated adherent plants, two produced adherent plants of brachytic stature, disposing of the hypothesis that normal stature is closely linked with the adherent variation. (See Fig. 17.) Eight brachytic plants produced by the progenies in which the adherent variation was found were self-pollinated. These eight plants were normal with respect to the adherent character but progenies of two of them segregated into normal, and adherent. The percentage of adherent plants in these two brachytic progenies is surprisingly large for a simple Mendelian character, but the populations were so small that the deviations may be due to chance. Plants combining the brachytic and adherent variations are extremely hard to propagate and no self-pollinated seed was obtained from them.

**PARTLY DISSECTED ADHERENT PLANT OF NORMAL STATURE**

Showing the twisted ear and the coalesced upper sheaths. Photograph natural size. (Fig. 19)

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**PARTLY DISSECTED ADHERENT PLANT OF NORMAL STATURE**

Showing the twisted ear and the coalesced upper sheaths. Photograph natural size. (Fig. 19)

A normal brachytic plant was crossed with an adherent plant of normal stature and the first generation segregated into equal number of brachytic and normal plants indicating that the adherent parent was heterozygous for brachysm, affording additional evidence that adherence is not linked with normal stature.

Considering the possibilities for variability in expression and the difficulty of propagating extreme plants it would seem not unreasonable to assume that adherence is a simple Mendelian character recessive to the normal condition and its linkage relations to the other variations should be studied. Owing to the difficulty in obtaining seed only very small quantities can be furnished interested investigators.

TABLE I — CLASSIFICATION OF THE PLANTS OF THE SECOND GENERATION OF THE BRACHYTIC-BOONE HYBRID WHICH PRODUCED ADHERENT PLANTS

| Progeny Designation | Normal Stature | | Brachytic Stature | | Adherent % in entire progeny | % Adherent in plants of normal stature |
|---|---|---|---|---|---|---|
| | Normal | Adherent | Normal | Adherent | | |
| Dh436W1L19..... | 66 | 17 | 18 | 0 | 16.8±2.49 | 20.5±2.98 |
| Dh436W2L19..... | 58 | 22 | 24 | 0 | 21.2±2.71 | 27.5±3.35 |
| Total..... | 124 | 39 | 42 | 0 | 19.0±1.85 | 23.9±2.25 |

TABLE II—*Classification of the Plants of the Progenies of the Adherent Variation*
(N=Normal; A=Adherent)

| PROGENY DESIGNATION | Seedlings | | Mature Plants | | | | Percent Adherent Seedlings | Percent Adherent Mature Plants | Percent Brachytic |
|---|---|---|---|---|---|---|---|---|---|
| | | | Normal Stature | | Brachytic Stature | | | | |
| | N | A | N | A | N | A | | | |
| Adherent Self-Pol..... | 27 | 10 | 0 | 22 | 0 | 8 | 27.0±4.9 | 100.0 | 26.7±5.4 |
| " " ..... | 74 | 41 | 2 | 34 | 0 | 0 | 35.6±3.0 | 94.4±2.6 | 0.0 |
| " " ..... | 44 | 18 | 3 | 23 | 1 | 5 | 29.0±3.9 | 87.5±3.5 | 18.8±4.7 |
| Adherent x Adherent..... | 25 | 32 | 4 | 28 | 0 | 0 | 56.2±4.4 | 87.5±3.9 | 0.0 |
| " " ..... | 114 | 34 | 12 | 12 | 7 | 3 | 23.0±2.3 | 44.1±5.7 | 29.4±5.3 |
| Brachytic Self-Pol..... | 53 | 13 | | | 13 | 9 | 19.7±3.3 | 40.9±7.1 | 100.0 |
| " " ..... | | | | | 19 | 17 | | 47.2±5.6 | 100.0 |
| Six sister brachytic progenies self-pol..... | | | | | 180 | | | 0.0 | 100.0 |
| Brachytic x Adherent $F_1$..... | | | 12 | | 12 | | | 0.0 | 52.2±7.0 |

# THE IMMIGRATION PROBLEM TODAY

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WE ARE facing the most serious crisis which has ever arisen in the history of immigration to the United States. The facts in the present situation should be widely known. Without an intelligent understanding of the problem, no sound and constructive immigration legislation can be framed. The essential facts are as follows. They are not exaggerated, and are all based on authoritative sources of information.

**First: The Rising Tide of Immigration**

As was to be expected, immigration has shown a tremendous increase during the past few months. Since July 1, 1920, the alien arrivals at the port of New York alone have averaged about 3000 a day. During the present calendar year the total has come close to 1,000,000, approximating pre-war figures. And, as Commissioner F. A. Wallis, New York, has put it, "All records are going to be shattered from January on." "Whole races of Europe are preparing to remove to the United States. Never since the early days of barbarian Europe has there been such a wholesale migration of population as that which is now in contemplation, with the United States as the destination." Considerably more than 1,000,000 aliens will come in 1921 unless we erect a barrier to cut down their numbers. On Nov. 15 last, more than 16,600 aliens were either at Ellis Island, or on ships in New York harbor awaiting inspection. On Dec. 19, 12,000 came in on eight steamships. These are not unique cases. Incoming steamers are crowded to their utmost capacity. A group of steamship agents not long ago told Commissioner Wallis that immigration to the United States had barely started; that 15,000,000 men, women and children, representing every nationality in Europe, are "fighting for passage to the United States." These estimates take no account of the German immigration which, in the opinion of every competent authority, will start to come here as soon as the existing technical state of war is terminated. This German immigration is estimated at from 2,000,000 to 10,000,000, with the balance of probability in favor of the larger figures. Surgeon-General H. S. Cumming, of the U. S. Public Health Service, has expressed it as his view that at least 7,000,000 people are trying to get here from European and Asiatic countries where serious epidemic diseases are rampant. In the opinion of Commissioner Wallis, as stated before the Senate Immigration Committee on Jan. 5, 1921, Eastern Europe "is in the grip of four epidemics—typhus, typhoid, dysentery and tuberculosis." The war has undermined the health of the natives of those countries, and such immigrants are "dangerous to the public health of the United States."

Such a situation has never before confronted us. This is not "normal" immigration. It is a frenzy, a panic, a stampede, a mob, without calculation, without sound judgment; a seething mass of humanity with but one idea—America.

**Second: The Undesirable Character of the Impending Immigration**

The most recent, unprejudiced and authoritative reports on the general conditions of the aliens who are planning to come to this country are those received by the Consular Service of the Department of State, from officers of this Government who have personally visited the various countries abroad.

This evidence is embodied, in a condensed form, in Report No. 1109, 66th Congress, 3rd Session (Dec. 6, 1920), submitted from the Committee on Immigration and Naturalization, to accompany House Bill No. 14461. It is clear that a majority of these prospective immigrants are "physically deficient"; "mentally deficient"; "economically undesirable"; "socially undesirable"; of low standards of living, "not of the most desirable class."

In the light of these reports by United States Consular Officers, the House Immigration Committee is certainly stating the case very mildly when it says in its own report: "The Committee is confirmed in the belief that the major portion of recent arrivals come without funds. It was apparent to the Committee that a large percentage of those arriving were incapable of earning a livelihood. . . . . A study of the new immigration from Central Europe convinced many members of the Immigration Committee that the arriving immigrants are not those who might go to farms; that they are not agriculturists, but mainly additional population for our principal coastal cities and congested industrial districts."

On this same point, the following statement from a foreign correspondent of the Philadelphia *Public Ledger*, in a cablegram dated Warsaw, Dec. 11, 1920, may be quoted:

"The most extraordinary, hopeless, destitute and pathetic emigration which the world has known now is making its way to America, the promised land, through Poland from as far east as Kief, and from the Russian territory north and east of the Black Sea. Even from Georgia, masses of poor, disease-laden people are making their way to America.

"Within three weeks, 150,000 have reached the Warsaw territory. This is only a beginning. Unfortunately, Bolshevist agitators and Communists are with the majority of the hordes and are confident that in the general confusion they will be able to get into America, where they propose to spread propaganda.

"American citizens in Warsaw are distressed and alarmed over the character of the immigration. . . .

"The Warsaw government has protested to the American consulate that the gathering of people in Warsaw is creating a dangerous health condition, asking that steps be taken to correct the conditions. The American officials have no power to check the Russian flood to Poland."

A recent writer has said: "Ignorant of our language, of our laws and institutions, of our industrial and agricultural methods, what would this seething mass of wretchedness do if dumped on our shores? What but add to its woes and our own? How could we make room for it? How educate it? How fit it for any part in our scheme?"

### Third: The Impossibility of Adequate Inspection

At best, during slack immigration, our inspection of incoming aliens is none too effective. Now, with the flood of immigration, medical and general inspection is hopelessly inadequate. Our laws for the exclusion of insane, idiotic, imbecile, feeble-minded and diseased immigrants are excellent, *on paper*. But when aliens file past the inspectors with more or less of the speed at which a line of people at a railroad station files by a ticket-window it is clear that most cases of mental and many of physical deficiency get by. The need of more "hands" to do our labor is constantly being urged. "Hands across the sea" are the cheapest, so we import them. Let us not forget that we are importing not "hands" alone but bodies and hereditary tendencies also. It is of vital consequence that the quality of these human beings who come to us from other lands should be of the best, so that they shall not injure but shall improve our stock. Every day that passes witnesses the landing on our shores of many aliens whose coming here is absolutely certain to result in a deterioration of the

mental and physical standards of the American race of the future. This is not a chance sensational statement. It is the conviction of competent medical authorities who know the present conditions of immigration, and the wholly perfunctory and inadequate medical inspection which passes the aliens without proper examination as to their physical and mental condition.

### Fourth: A Period of Unemployment Has Begun, and Immigration is Not Needed to Supply Labor

The enormous industrial demands during the war, and the later expansion of our export trade, naturally resulted in a great influx of workers from the country districts into the cities, and of a very considerable abandonment of domestic service for the better paid positions in industry. This change in the conditions of employment brought about a shortage of farm labor and also a shortage of domestic servants. But the tide has turned. There is a general slackening of industrial activity. Mills and shops are slowing down or closing. In many cases employees have been willing to accept a reduction in wages rather than have their jobs cease altogether for a time. We are facing a period of general unemployment. Already a flow of labor from the cities to the country is reported to be setting in, and farm labor will again be supplied by men who left the farms for the mills and machine shops. On the other hand, also, thousands of women who left domestic service for industrial work will soon be ready to go back to their old jobs, and at lower wages than they have been receiving in industry. In other words, the crisis in the labor situation has passed. Unemployment will increase. A wholesale immigration is not needed, and will greatly aggravate the approaching economic situation.

There is surely something radically wrong in the following situation: Hundreds of thousands of men and women already in the United States are out of work, and their number is increasing daily. Congress and State and municipal authorities are being urged to provide work and support for these people at public expense. Yet every week there are being landed at our ports thousands of aliens, the large majority of whom are very close to the pauper line, and all of whom must, in some way or other, be provided with work, or else be supported by public or private funds. Where is the logic, or the justice, in such a condition of things? Canada, which handles its problem of alien immigration far more effectively and far more intelligently than we handle ours, has recently increased the individual financial entrance requirement to $250 in order to improve the condition of unemployment now prevailing in the Dominion.[1]

### Fifth: Present and Impending Immigration Will Not Furnish the Kind of Labor Needed on Farms

This point has already been emphasized in the Consular Reports and in the Report of the House Immigration Committee above referred to. Only 2.8% of the immigrants of the past year purported to be "farmer." Our past experience has shown that immigrants inevitably flock to centers where their compatriots are already congregated. This is happening now. The large majority of incoming aliens are going to our great cities, and to the congested districts. Delegations of representative citizens from certain Western cities have recently been to

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[1] "Paragraphs 1 to 3 of the former Order-in-Council, applicable to mechanics, artisans and laborers, have been suspended, and four others substituted, by which "no immigrant of the mechanic, artisan or laborer classes, whether skilled or unskilled, shall be allowed to land in Canada unless he possesses in his own right money to the amount of $250, and in addition transportation to his destination in Canada. If an immigrant in the classes mentioned is accompanied by his family, he must possess in addition to transportation for his family to their destination, a further sum of $125 for every member eighteen years old or over and $50 for each child to five years old and under eighteen years."

Ellis Island, to urge upon the Commissioner of Immigration there the importance of sending the new arrivals to the farming districts, in order that the cities from which these delegations came may not be further burdened with great numbers of new immigrants. The Federal authorities are said to be doing what they can to "distribute" as many aliens as possible. But, as President Roosevelt well said in one of his messages to Congress, "distribution is a palliative, not a cure." Even if many thousands of aliens were actually "distributed" where there is a lack of farm laborers, the majority of them would not be effective. What our great farming districts need is highly intelligent labor. They want men who are skilled in American farming methods. They want men who can manage modern agricultural machinery. They do not want ignorant, unskilled, non-English-speaking foreigners, who know little beyond the use of a primitive kind of hoe. The writer has talked with many men who own large farms in the Middle West, and he has found them of one mind on this matter.

It is highly significant that at the 40th Annual Session of the Farmers' National Congress, held at Columbus, Ohio, with delegates from over 30 States in attendance, the following resolution was unanimously adopted (Nov. 19, 1920): "Resolved, That we are unalterably opposed to the proposed diversion and distribution of aliens over the farming districts until immigration is rigidly restricted, numerically or otherwise."

### Sixth: A Large Immigration Vastly Increases and Complicates Our Task of Americanization

The sudden outburst of patriotic desire to Americanize our unassimilated alien population was a direct result of the war. The nation came all at once to realize how vitally necessary it is to weld our heterogeneous population into a more homogeneous whole. The problem of illiteracy among our native-born, serious enough itself, has been very greatly complicated by allowing millions of aliens who cannot speak, or understand, or read English to land on our shores. The first stage in making Americans out of our foreign-born population must be to give them a speaking and reading knowledge of English. There is a limit to our national power of assimilation. To allow immigration to continue in the years to come at its prewar rate, or at what will doubtless be an even higher rate, is like trying to keep a boat bailed out without stopping the leak. A further restriction of immigration is a necessary and logical part of the Americanization program.

One of the most significant statements regarding the bearing of recent immigration upon the general problems of assimilation and of Americanization was that made by the November Grand Jury of King's County, N. Y. This body, on Dec. 3, 1920, handed to County Judge May a presentment urging legislation by Congress to "prohibit the immigration into this country of all who cannot read and write English and who do not possess an intelligent understanding of the fundamental ideas of human liberty."

"The stream of our national life," the presentment continued, "cannot rise higher than its source. To permit any further pollution of this stream is to intensify both our foreign as well as our domestic problems. It will foster disunion, instead of promoting union. Instead of continuing as a nation of high ideals, we shall degenerate into a mere medley of races, a hodgepodge of nationalities."

These are strong words, but everyone who has studied our national and municipal problems knows that they are true.

### Seventh: The Ethics of Immigration Restriction

When refugees from war-stricken Europe are mentioned, there naturally arises in our minds the thought, "Is it right for us to prevent any of these people from coming here? Is it not un-American; contrary to our 'traditional' policy of providing 'a refuge

for the oppressed?' " Sentiment can never solve great national problems. The indiscriminate kindness which we may seem to be able to show to the coming millions of European and Asiatic immigrants can in no conceivable way counter-balance the harm that these people may do to our race, especially if large numbers of them are mentally and physically unfit.

Indiscriminate hospitality to immigrants is a supremely short-sighted, selfish, ungenerous, un-American policy. It may give some of us, for the moment, a comfortable feeling that we are providing a "refuge for the oppressed." But that is as narrow a state of mind as that which indiscriminately gives alms to any person on the street who asks for money. Such "charity" may, truly, produce a warm feeling of personal generosity in the giver himself. But alms-giving of this sort does more harm than good. It is likely to pauperize him who receives, and it inevitably increases the burden of pauperism which future generations will have to bear. We have no right to saddle any additional burdens upon the already overburdened coming generations of Americans. It is in the highest degree un-American for us to permit any such influx of alien immigrants as will make the process of assimilation and amalgamation of our foreign population any more difficult than it already is. The situation is discouraging enough already.

Our policy of admitting freely practically all who have wished to come, and of encouraging them in every possible way to come, has not only tremendously complicated all our own national problems but has not helped the introduction of political, social, economic and educational reforms abroad. Indeed, it has rather delayed the progress of these very movements in which we, as Americans, are so vitally interested. Had the millions of immigrants who have come to us within the last quarter-century remained at home, they would have insisted on the introduction of reforms in their own countries which have been delayed, decade after decade, because the discontent of Europe found a safety-valve by flying to America. We are constantly told by our idealists that the "cream" and the "pick" of Europe has been coming here because it is discontented at home; because it wants political and religious and economic liberty; because it wants education, and better living conditions, and democratic institutions. Have we in any way really helped the progress of these reforms by keeping the safety-valve open? By allowing the discontented millions of Europe and of Asia to come here now, are we likely to hasten, or to delay, the coming of political and social reforms in Armenia, in Russia, in Turkey? Our duty as Americans, interested in the world-wide progress of education, of religious liberty, of democratic institutions, is to do everything in our power to preserve our own institutions intact, and at the same time to help the discontented millions of Europe and of Asia to stay in their own countries; to shoulder their own responsibilities; to work out there, for themselves, what our own forefathers worked out here, for us and for our children.

### Eighth: The Necessity for Further Restrictive Legislation

Our existing general immigration law was never designed to meet the present emergency. It is a selective, rather than a restrictive, measure. When it was enacted it was thought sufficient. But now the whole situation has changed. From all sorts and conditions of people, the country over, comes a strong and increasingly vehement demand for further legislation which shall effectively cut down the alien invasion which threatens us. Opposition to further legislation is limited to certain racial groups which are chiefly interested, not in the future of America but in the future of their race in America; to exploiters of "cheap labor," and to those who have been well termed "the incurable sentimentalists."

The House of Representatives, in December, passed a bill which has been widely, and most inaccurately,

termed a one year total exclusion bill. The measure, known as the Johnson bill, does not suspend immigration. It would limit it, for a period of one year after enactment, to the near blood-relations of naturalized citizens of foreign birth, and of aliens who apply for naturalization. What the numbers of these relatives may be, no one can tell, but it is perfectly safe to say that several hundreds of thousands of immigrants could be admitted if the bill became law. Further, there are provisions for the admission of unskilled laborers, and of domestic servants, and for the suspension of the illiteracy test in certain cases. The measure, then, while giving us more restriction than we have at present, is in no way drastic, and by no means meets the emergency. The Senate has, at present writing, taken no action.

That additional legislation is needed, and needed at once, is the conviction of every competent and unprejudiced student of our immigration problems. Among the many suggestions which have been made is the proposal which rests on the conviction that one of the best evidences that our different groups of foreigners have been assimilated is that they have become naturalized. The plan is to limit the number of new alien arrivals who shall be admitted from a country in any one year to a certain percentage of our previous immigrants from that country who have since become naturalized in the United States. According to the provisions of some of these bills, the exact percentage, within certain fixed limits, is to be determined by the Secretary of Labor, or by a commission, with reference to the labor conditions which may exist at the time. Such a plan has the merit of being more than a temporary measure; of being simple, direct and logical, and also of being sufficiently elastic to respond to varying economic conditions.

There is no subject before Congress of equal importance to that of immigration, which touches our National life in so many ways. Immigration has far-reaching economic and political effects, but its effects upon the character of the race are the most important of all. Congress will act, and act wisely and quickly, if the will of the great mass of our people who believe in restriction makes itself felt. But if we do not bestir ourselves, the steamship companies, and the large employers of "cheap labor," and the societies of foreign-born hyphenates will carry the day, as they have so often done in the past.

The economic aspects of immigration are those which are still given the most prominence, and which attract most public attention. Those of us who are concerned chiefly with problems of heredity and who demand a far more careful selection of the incoming aliens on the basis of their mental and physical condition, are, however, entirely in accord with those who ask for a further numerical restriction for economic reasons. Two things are absolutely essential. The first is a rigid and impartial enforcement of the existing law regarding the exclusion of mentally and physically undesirable aliens. The second is a radical reduction in the numbers of aliens who shall be admitted to the United States in any year. It cannot be too often or too strongly emphasized that, as Dr. T. W. Salmon pointed out several years ago, any measure which checks the flow of immigration in general must necessarily result in the admission of fewer mentally and physically undesirable immigrants. Further, with a reduction in the numbers, medical and general inspection can always be far more effective, and the aliens with mental and physical defects which render them highly undesirable as contributors to the blood of the American stock can be more often detected and debarred. Thus those who are primarily concerned about the character of the future American people have every reason for uniting with those who are chiefly interested in the purely economic aspects of alien immigration in demanding (1) a strict enforcement of existing law, and (2) a radical reduction of the numbers of aliens who shall be permitted to enter the United States. *Jan. 1, 1921.*

# ARE VALENCIA ORANGES FROM CHINA?

## The Occurrence in South China of Oranges Closely Resembling Strains of the Valencia Variety Suggests the Latter's Origin There

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THE introduction of the Valencia orange into Florida and California is a subject which has been fully discussed and is a matter of definite record by Shamel, Scott and Pomeroy.[4] To briefly summarize their findings: The variety was introduced into California about 1876 by the Thomas Rivers Nurseries of London, England. The name of the variety having been lost, it was later identified by a Spanish orange grower visiting in California, as a variety grown in Spain called "La Naranja Tarde de Valencia." After that the name Valencia was adopted for the variety in California. Previous to 1876 the same variety had been introduced into Florida where it was known by the names "Brown" and "Hart's Late." Trees of these introductions were later shipped to California and when they came into bearing the fruits and trees were found to be identical with those of the variety grown in that state under the name Valencia.

### TWELVE STRAINS OF THIS VARIETY

No definite evidence is available concerning the history of the variety prior to its distribution by the Rivers Nurseries. The Valencia variety, as cultivated in the United States, does not represent one single strain; investigations conducted by the Office of Horticultural and Pomological Investigations, U. S. Department of Agriculture, have revealed that there are twelve important strains within this variety.

In 1918 the senior writer visited southern China in continuance of citrus canker studies. At Sunwui, Kwangtung Province, near Hong Kong, fruits were observed which very closely resembled one strain of the Valencia as grown in California, and fruits were collected as specimens for identification in Washington. At Kua Tscha near Swatow, Kwangtung Province, trees of the sweet orange were observed which also bore fruits resembling another strain of the Valencia orange. Fruits and foliage of these trees were collected but unfortunately the foliage specimens moulded and were discarded. The foliage was, however, of the same type as that which in general characterizes the Mediterranean varieties of the sweet orange (*Citrus sinensis*). Trees both at Sunwui and at Kua Tscha were photographed and one is shown in an accompanying figure. The trees were grafted upon a native mandarin orange (*Citrus nobilis*) stock, which apparently dwarfed them to some extent. At Sunwui, the growers, questioned as to where the bud wood was obtained, stated that they bought their trees already budded from a nearby locality. The nurserymen, questioned as to where they had obtained these buds, stated that they had for many years obtained them from nearby trees. Apparently they did not recog-

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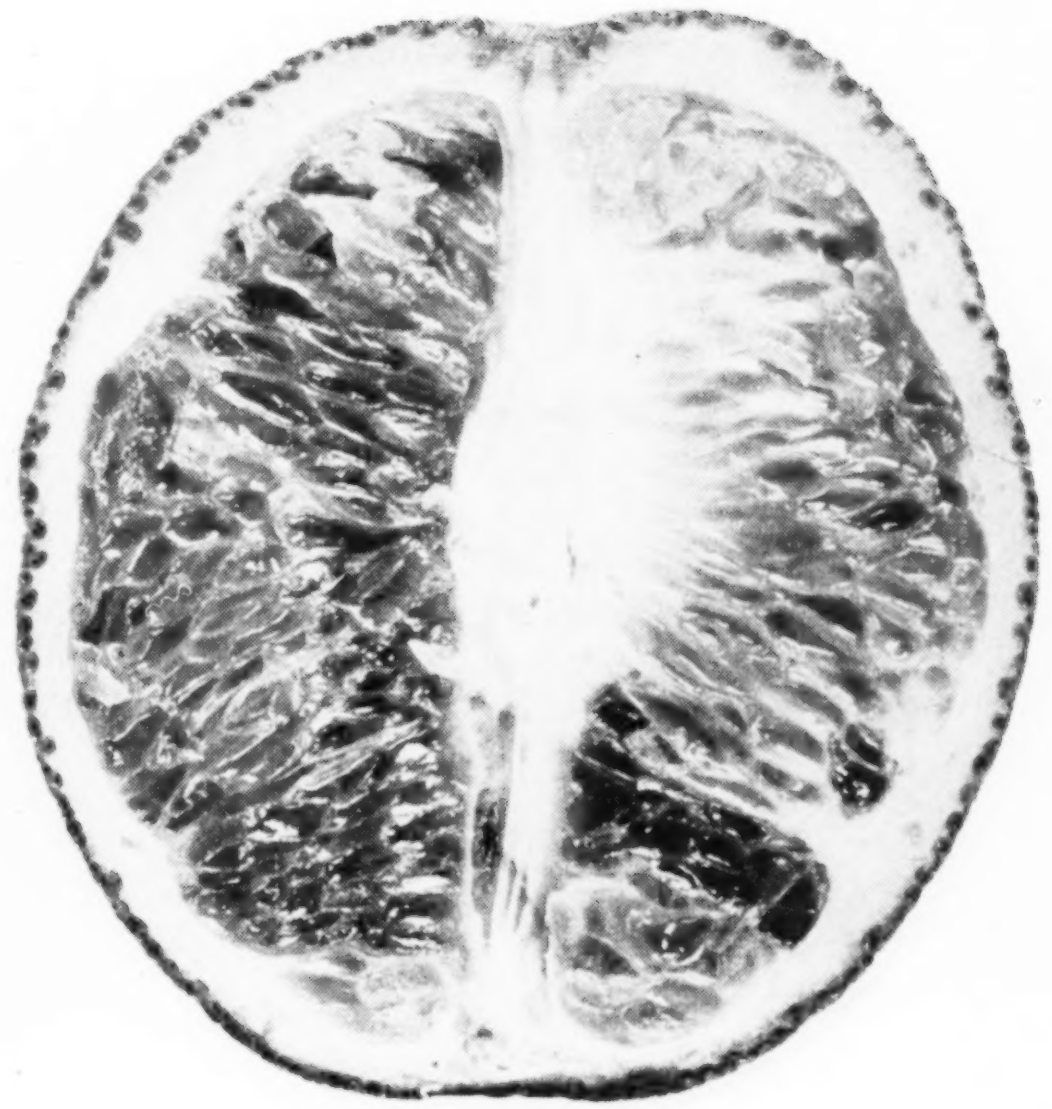
[3] The writers express their thanks to Mr. T. Ralph Robinson of the Bureau of Plant Industry, U. S. Department of Agriculture for assistance in connection with this paper.

[4] Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus Fruit Improvement: A Study of Bud Variation in the Valencia Orange. U. S. Dept. of Agr. Bull. No. 624.



ORANGE FRUITS FROM SUNWUI, CHINA

These fruits, carried to Washington from Sunwui, China, were found to agree in appearance and detailed characters with fruits of the Long strain of the Valencia variety orange as grown in California. Their texture is somewhat rougher than the Smooth strain, the juice abundant and sweet and the color a bright orange; seeds average one to two per fruit. (Fig. 20.)

"SOH KAA" OR "COOLIE ORANGES" FROM KUA TACHA, NEAR SWATOW, CHINA

These fruits resemble the Smooth strain of Valencia oranges in their detailed characters, but are smaller. The rind is very thin, juice sweet and abundant, and the color a reddish orange. (Fig. 21.)

**ORANGE TREE AT SUNWUI NEAR HONGKONG, CHINA**

The fruits of this tree resemble the smooth strain of the Valencia variety; the habit of growth and foliage characteristics are also similar. The long white leafless canes in the foreground are mulberry bushes, which in China are frequently interplanted between the rows of citrus orchards. (Fig. 22.)

nize it as a distinct variety among the sweet oranges.

At Kua Tscha the nurserymen were questioned as to the origin of the bud wood. They did not recognize the trees bearing these fruits as belonging to a distinct variety; they merely obtained bud wood from nearby trees of the locality. All sweet oranges (*Citrus sinensis*) were called "Soh Kaa," which translated means "coolie orange," and there seemed to be no special name for this variety in this locality. None of the growers knew of the time of the advent of this orange into their locality and seemed to regard it as having been the usual fruit for years

The above information was obtained through the very kind and explicit interpreting of Mr. Chang, Interpreter of the American Consulate, Swatow.

### SIMILAR FRUITS FROM CHINA

The fruit specimens collected at Sunwui and Kua Tscha were carried to Washington for determination. Examination by the junior writer evidenced that they corresponded very closely with the descriptions and detailed characters of the Smooth and Long strains of the California Valencia variety as described by Shamel, Scott, and Pomeroy in the publication previously mentioned. The fruits were, of course, not in the best of condition, having been six weeks en route from Hong Kong to Washington without

refrigeration; the fruits are shown in accompanying photographs. The description of these fruits follows:

The Soh Kaa from Kua Tscha: The trees of the strain from Kua Tscha have an upright, spreading habit of growth. The foliage and other tree characteristics are similar to those of trees of the Smooth strain. The fruits are smaller than the fruits of the Smooth strain, but have somewhat the same shape; texture of skin smooth; color reddish orange; rind very thin; rag tender; juice abundant, sweet; seeds averaging a few to each fruit. The fruits agree in description very closely with fruits of the Smooth strain.

The Sunwui fruits: The habit of growth and foliage characteristics of the trees are similar to those of the Valencia and Long strains. The fruits are cylindrical and long; size, small to medium; texture somewhat rougher than Smooth strain; color bright orange; rag tender; juice abundant, sweet, of good quality; seeds averaging 1 to 2 per fruit. The fruits agree very closely in description with fruits of the Long strain.

Chinese growers are not active along the lines of plant introduction and the adoption of methods and ideas from the Occident is slow. It is hardly probable therefore that we are dealing in China with introductions from America.

Sunwui, the point at which one of these strains was discovered, is situated in the delta of the Canton River, and but four or five miles from the city of Kong Moon. Various histories of China record the activities of Spanish and Portuguese merchants at the port of Kong Moon in the early days of foreign trade with China. The interest of such traders in economic plant materials is shown by the many definitely recorded plant introductions made to and from the Philippines. The Spanish, moreover, apparently were especially interested in orange culture, for wherever they colonized orange culture followed them. Thus a map showing where orange trees have become established would coincide very closely with a map showing the Spanish expansion in the 16th, 17th and 18th centuries.

The finding of these strains of an orange in South China, similar to certain strains of the Valencia in the United States, is suggestive of the origin of the Valencia in China and that it was carried from there to Spain, Portugal, the Azores or other Mediterranean countries by the Spanish or Portuguese traders. In one of these countries it was found and subsequently went to Florida and California through the agency of the Rivers Nurseries.

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## SCIENCE AT SECOND HAND

THE ALMOSTS: a study of the feebleminded, by Helen MacMurchy. Pp. 178, price $1.50. Boston, Houghton Mifflin Co., 1920.

Miss MacMurchy strikes her keynote in her first sentence: "Sometimes the poet sees more than the scientist, even when the scientific man is playing at his own game." If fiction had been more carefully studied, she avers that "we might have come sooner to some of the alleged discoveries of the twentieth century." One of these alleged discoveries is apparently the fact of feeblemindedness; and to atone for the neglect of past fiction readers, Miss MacMurchy has diligently studied Shakespeare, Bunyan, Scott, Dickens, Bulwer Lytton, Charles Reade, and a dozen others down to Kate Douglas Wiggin and the Contributors Club of the Atlantic Monthly.

"Touchstone is probably mentally defective, but it is quite possible that the fool in 'Lear' may have been insane, though certain of his words and actions remind one forcibly of a mentally defective person." And so on. Those who like to study human nature thus far removed from reality will like the book. The last chapter is a sentimental statement of "The Case for the Feebleminded" which, while containing nothing new, is on the whole sound. The writer urges custodial care and every endeavor to make the feebleminded "happy, safe, and useful." P. P.

# A CASE OF INHERITED SYNDACTYLY IN MAN

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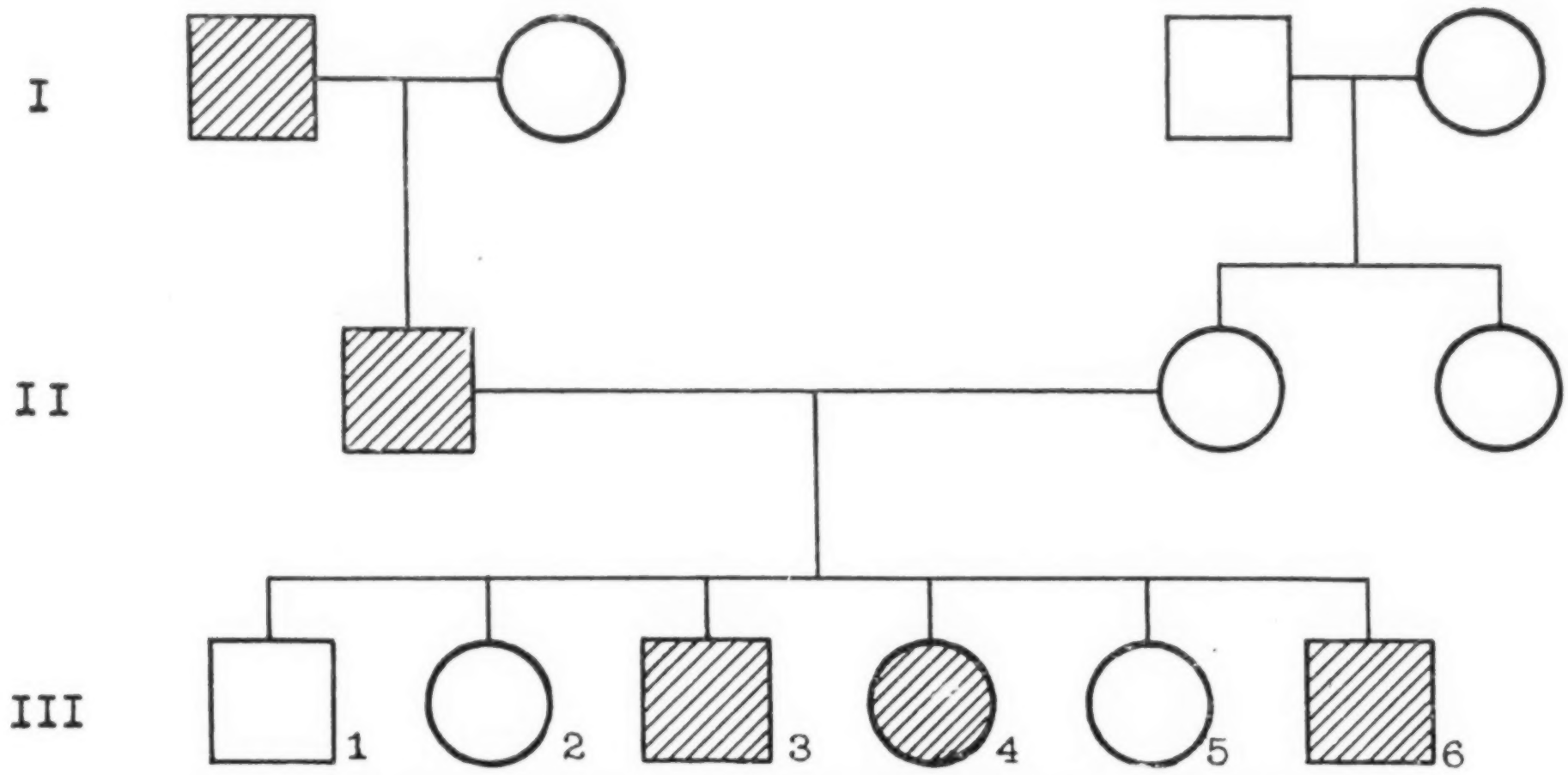
THE following account of the inheritance of limited syndactyly through three generations is reported for the purpose of placing the case on record. Syndactyly, or webbed digits, is recognized as a dominant Mendelian trait in man and a number of instances of its inheritance have been reported before. There appears, however, much variation in the number of digits affected and in the extent of the web along the digits, in view of which full recording of such pedigrees is worth while.

In this family the web occurs only on the feet and only between the second and third toes. In each case it is present on both feet. The character of the web is indicated by the accompanying X-ray photograph, Figure 23. The skeleton is entirely normal, but the second and third digits are united be-

**X-RAY PHOTOGRAPH OF WEBBED FOOT**

This is a case of limited syndactyly. The web occurs in this family only between the second and third toes, and was present in each case on both feet. This photograph shows plainly the joining of the second and third digits beyond the first joint. (Fig. 23.)




INHERITANCE OF WEBBED FEET IN THREE GENERATIONS

The shaded symbols indicate the persons having webbed digits. In the first generation, the father transmitted the character to his only son, who in turn transmitted it to three of his six children—two sons and a daughter. (Fig. 24.)

yond the first joint by fleshy parts.

The inheritance is represented in Figure 24, in which squares indicate males, circles females, and shading the presence of the web. The trait cannot be traced back of the paternal grandfather, who is represented by the shaded square in generation I in the diagram. He had transmitted it to his only child, a son, who passed it to half of his offspring. Of the six children in generation III, two sons and one daughter exhibit the web. The Mendelian expectation happens to have been exactly fulfilled.

The web is known to have been well defined in the case of the grandfather. In the father the condition is described as similar to that shown in the photograph, with slightly greater extent on the left than on the right foot. In the third generation, in child number 3 the condition is that photographed; in number 6 the web is somewhat less pronounced; and in number 4 it is reported as distinct but not especially noticeable.

This inheritance occurs in a branch of an old New England family whose genealogy has been fully investigated and published. The grandfather here mentioned was one of ten children and his father one of six. Yet it has not been possible to discover that this supposedly dominant trait occurs in any of the collateral lines. The possibility is suggested that the trait may frequently exist, as happens in one member of this third generation, as a slight and not particularly noticeable web.

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SEX ATTRACTION, by Victor C. Vaughan, Sc.D., M.D., LL.D., professor of hygiene and physiological chemistry, and dean of the University of Michigan School of Medicine, Ann Arbor, Mich. Pp. 44, price 50c. St. Louis, C. V. Mosby Co., 1920.

In this lecture Dr. Vaughan describes briefly the evoluton of sex and the basis of the physiological attraction between the sexes in the human species at the present time. The point of view is that of the eugenist. Emphasis is laid on sex education, and proper sexual selection.

# RACIAL DIFFERENCES IN MORTALITY

BY AN ANALYSIS of census figures, Louis I. Dublin and Gladden W. Baker discover significant differences in the mortality of various racial stocks in Pennsylvania. Their study is reported in the *Quarterly Publication* of the American Statistical Association, March, 1920.

Differences of this kind have an important bearing on evolution, and on the future composition of the American population. The conclusions which the authors reach are:

1. Of the three main groups of the white population in Pennsylvania and in New York—(*a*) native born of native parents, (*b*) native born of foreign or mixed parentage, and (*c*) foreign born—the first has the lowest mortality. This is true for both sexes and for virtually every age period, but is most marked at the adult ages.

2. The foreign born, and the native born of foreign or mixed parentage, agree much more closely with each other than with the native stock. An interesting exception presents itself however, at the ages from 25 to 44 during which period the foreign born have a great advantage over the native born of foreign or mixed parentage. The reason for this is the predominance of the Irish, German and British stocks among the first generation Americans at this age period. After the age of 45 these two groups of the foreign stock are of the same racial extraction and their death rates are in very close agreement.

3. The death rates of the component groups among the foreign born vary considerably. The Austro-Hungarians, Russians and Italians present altogether favorable conditions, while the British, Germans and Irish show death rates very greatly in excess. This is especially true of the Irish whose mortality is about double that of the native stock. The death rates for the Germans, British and Irish are much higher in America than in their own countries. Pulmonary tuberculosis, pneumonia and the degenerative diseases, including heart disease, Bright's disease, and cancer, are largely responsible for this unfavorable mortality.

4. The findings of the previous study for New York State are confirmed. The unfavorable conditions of life and work among foreign races to which attention was directed in the study for New York are found to prevail in Pennsylvania as well. The facts emphasize the necessity for special public health work for the people of foreign origin. The much more favorable economic conditions under which they live in the United States than in their own countries should result in lower death rates. But in several instances we found that this does not prevail; the facts indicate, on the whole, deterioration rather than improvement. Is it possible that our immigrants are not representative of the best in their native countries? It has often been supposed that the immigrants comprised the most vigorous among their own people; the results however, do not confirm this impression, but suggest many questions for further inquiry.

5. It is very important that a study similar to this one be carried out as soon as the final results of the 1920 census are available, to determine whether any differences of importance have appeared in the interval of ten years.

## Good Practical Eugenics

THE BOOK OF MARJORIE. Pp. 128. New York, Alfred A. Knopf, 1920.

This anonymous and charming book, apparently written by a New York newspaper man, is one of the best pieces of practical eugenics propaganda that has come to light for some time. It is the story of the author's love and marriage, and of the days when he and Marjorie awaited the birth of their first child. As a sane, interesting, modern, wholesome study of the psychology of married life, and of expectant parenthood, it is almost in a class by itself. The book is worth reading.—P. P.